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environmental quality

the fifth annual report
of the council
on environmental
quality

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The President's Message

The President's Message

To the Congress of the United States:

I am pleased to transmit to the Congress the Fifth Annual Report of the Council on Environmental Quality.

When future historians look back on the pursuit of environmental quality in our era, they will recognize it as a positive turning point.

As I stated in an Earth Day speech in 1970, "the day is gone when concern for the land, the air, and the water was sole province of the conservationist, the wilderness enthusiast, the bird watcher, and the environmental scientist."

Instead, today, millions of our citizens share a new vision of the future in which natural systems can be protected, pollution can be controlled, and our natural heritage will be preserved. The crusade to improve the quality of our human environment has begun—a crusade which has already led to great accomplishment over the past five years.

Another valuable lesson was learned during the energy crisis last winter when, in trying circumstances, it became clear that we cannot achieve all our environmental and all our energy and economic goals at the same time. Had our commitment to the environment not been ingrained, we might have reacted to this situation by discarding our environmental goals. Had our commitment to the environment not been mature, we might not have recognized the need for balance to accommodate other social and economic goals as well. By rejecting the extremes—by accepting the need for balance—we held fast to the accomplishments of the past and looked with new perspective toward the imperatives of the future. This, in my judgment, is the course we must continue to follow.

The need to move toward greater self-sufficiency in energy is one of the major challenges of the decade ahead. We can and must meet our needs for energy, and in ways that minimize damage to the environment.

The conservation of energy provides an essential common ground between our need for energy and our desire to protect the environment. By eliminating waste in the use of energy, and by increasing the efficiency of the energy we use, we can move toward both goals

simultaneously. Our experience this year has shown that there are major opportunities to conserve energy. And we are coming to understand that actions which temper our growing use of energy contribute to self-sufficiency as well as actions which increase our domestic supply.

We must also recognize that, even with a strong conservation program, we will still have to mine more coal, drill for more oil and gas, and build more powerplants and refineries. Each of these measures will have an impact on the environment. Yet this can be minimized, and the last five years have shown that we have the capacity and the willingness to do so. Science and technology, in which America excels, provides one means of limiting environmental damage; careful analysis and planning, with broad public participation, offers another.

Let us also be guided by our increased recognition of the interdependence of all nations of our globe and the fundamental relationship between population, resources, economic development, world stability, and the environment.

No longer is concern for the environment the dream of a few. Instead, it is reflected in countless actions by many citizens, by industry, and by government at all levels every day. The environmental movement has matured, and the nation and its environment have benefitted in the process. Looking to the future, we can expect further accomplishment in enhancing our environment and, along with it, further improvement in our quality of life.

Gerald R. Ford

The White House, *December 1974*

The Fifth Annual Report of the Council on Environmental Quality

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N. W.
WASHINGTON, D. C. 20006

LETTER OF TRANSMITTAL

THE PRESIDENT:

Sir: The Council on Environmental Quality herewith submits its fifth Annual Environmental Quality Report, December 1974, in accordance with Section 201 of the National Environmental Policy Act of 1969 (42 U.S.C. 4341).

Respectfully,

Russell W. Peterson

Russell W. Peterson
Chairman

John A. Busterud

John A. Busterud

Beatrice E. Willard

Beatrice E. Willard

Highlights

1. Land Use

This chapter provides an overview of current knowledge about a number of land use issues: the environment, economic, and social impacts of land development; the various stimulants which affect development; and the different tools available to control the pace and character of development.

- "To define and achieve good use of land may well be the most fundamental of all environmental objectives. In the broadest sense, the way in which we use our land determines the way in which our society functions." (p. 1)

Effects of Development

- "Urbanization and suburbanization have been the predominant characteristics of population shifts in the United States over the past two decades. Approximately 70 percent of all Americans live in metropolitan areas, and over half of those in the suburbs alone." (p. 3)
- "*The Costs of Sprawl* study shows that even with quarter-acre lots, the low density sprawl community may consume over one-half an acre per dwelling unit, more than twice as much land as the high density planned community." (p. 8)
- "In terms of total public and private investment cost to occupants, taxpayers, and municipal governments, *The Costs of Sprawl* study found that the high density planned community costs 21 percent less than the combination mix community and 44 percent less than the low density sprawl community." (p. 9)
- "Overall, the high density planned community generates about 45 percent less air pollution than the low density sprawl community housing the same number of people. The simple clustering of houses alone can reduce the amount of air pollution from automobiles by 20 to 30 percent." (p. 12)
- "The community development pattern can also have significant impacts on energy consumption through affecting how much automobiles are used. Results from *The Costs of Sprawl* and other studies indicate that better planning, clustering, and higher density can all significantly reduce reliance on auto travel . . ." (p. 17)

- "Today approximately 3.4 million American families own second homes. Including owners of recreational lots, a total of from 5 to 7 million American families are estimated to own recreational properties of some kind. . . . [leisure homes] are no longer the province of the very wealthy." (p. 21)
- ". . . [leisure home] development brings what amounts to instant urbanization to rural communities—communities where local governments have little experience with the impacts of large-scale development and few land use controls or regulatory bodies to deal with them." (p. 24)
- "None of this should lead us to conclude that growth is wrong or that land development should not occur. On the contrary, the market will demand new housing and new recreation opportunities for a population that, even at current low birth rates, will continue to expand (for at least the next few decades) and become more affluent. The issue is not growth or no growth. Rather, it is how and where and under what conditions growth should occur." (p. 26)

Development Stimulants

- ". . . we are beginning to realize that it is possible to identify major stimulants to growth which can be controlled, and we are beginning to learn how to predict some consequences of these stimulants before they occur. While much work remains to be done in improving these predictive techniques, there is increasing interest in taking a hard look at the way . . . major decisions stimulate surrounding development of all kinds." (p. 27)
- "Federal taxes are widely recognized as having substantial impacts upon development decisions and land use, primarily because they treat some types of development more favorably than others." (p. 28)
- "In summary, it is clear that the Clean Air Act and the Federal Water Pollution Control Act have potentially significant land use impacts . . . in some cases the impacts may not only conflict with other social and environmental goals but may also be perverse in terms of the attainment of the pollution control goals of the Act from which they derive." (p. 36)
- ". . . the funding of new public facilities probably has the most direct and immediate impact on specific land areas. The influence of highways on land values and development decisions is understood best. . . . But new sewers are becoming in many metropolitan areas the prime determinants of where and how fast new development occurs." (p. 36)
- "While annual or biennial extensions of interceptors might make the sewer cost somewhat higher and the funding mechanism more complicated, it would probably result in overall cost savings to the community and would significantly reduce adverse land use impacts." (p. 39)
- "The impact of a highway—particularly on residential development—is strongly influenced by the amount of vacant land it opens up for development relative to what is already accessible. The first interstate highways in metropolitan areas had substantial impact because they opened up relatively large amounts of land. Later highways may have less impact because they are built in areas that already have some access." (p. 42)
- ". . . there are some [energy-related] decisions that may have an impact on regional growth. This is exemplified by proposed energy-related developments—deepwater ports for supertankers, outer continental shelf oil and gas production, extensive strip mining of western coal, the Alaska

pipeline, and the production of crude petroleum from oil shale. In addition to affecting air and water quality, water supplies, marine resources, wildlife, and land resources, these facilities are expected to generate substantial industrial, commercial, and residential development." (p. 44)

- ". . . local planning officials are beginning to recognize how the stimulating effects of infrastructure investments can become a tool in controlling development. By carefully planning where the investments will be made and how they will be staged, local, regional, and state officials can strongly influence where, how, and when [development occurs]." (p. 48)

Land Use Controls

- "Since the publication of *The Quiet Revolution,* efforts to strengthen the role of the states and their regional governments in regulating the use of land have continued. Forty-eight states have now enacted legislation or are seriously studying proposals to expand the previously limited role of state government in the regulation of land use." (p. 49)
- "Zoning, the most common system of land use control, attempts to predesignate the purposes for which land can be used. In doing so, it serves to segregate uses into assigned geographic areas, keeping, for example, heavy industries apart from residences, or even single family housing apart from multifamily housing." (p. 51)
- "Each of these approaches seeks to resolve a very important question in land use regulation: to what extent should controls be exercised through traditional zoning methods of predesignating permitted uses, and to what extent should each development proposal be given special review? . . . the current trend is clearly toward more case-by-case review as the only way to assure adequate sensitivity to community and environmental impacts." (p. 55)
- "Despite . . . legal intricacies and . . . financial limitations, there is increasing interest in a wide range of approaches to development rights as a part of the community's land use controls. New approaches include donations, transfers, and other devices in addition to purchase of these rights." (p. 56)
- "Whether the development rights transfer approach should achieve wider application and even replace zoning and other traditional land use controls may soon become a major topic of debate." (p. 59)
- "Another potential mechanism for public control over development is land banking. This approach involves the acquisition by the community of extensive undeveloped land surrounding the community with subsequent resale of parcels and tracts to developers in a way that effectively controls the rate and pattern of urbanization." (p. 59)
- . . . citizens in many communities share a feeling that the development process is out of control, that decisions are made which benefit only the influential developers' interests, and that piecemeal changes are having unpredictable cumulative effects on the quality of life. . . . The reaction in many localities is a strong citizen effort to slow or stop growth." (p. 61)
- "Another land use control which has become popular in recent years is preferential tax assessments for certain types of real property. Preferential taxation is a method of lowering the tax burden on land such as farms or forests or historic districts which the community wishes to preserve by assessing at less than its full market value." (p. 64)
- "Traditionally, open space has been considered a beneficial public expenditure in itself; there has always been substantial interest in preserv-

ing open space for visual amenity, outdoor recreation, natural resource conservation, flood prevention, and preservation of agricultural lands. But it is also recognized as a mechanism for the containment and guidance of growth." (p. 68)

- "There is increasing evidence that open space preservation is economically beneficial to all—the developer, the resident, and the local government." (p. 69)
- "Once this interrelationship is understood—that stimulants like highways and sewers can be used to control growth, and that controls like zoning and preferential assessment can be used to stimulate the development of certain areas—a community can begin to formulate a strategy for land use regulation." (p. 70)

Conclusion

- "Any progress toward better land use must . . . be measured not in terms of the sophistication of legal devices or the complexity of approval mechanisms developed by different levels of government. What is important is how such controls and stimulants can be used to influence the private sector in its decisions about how to use the land." (p. 72)

2. Perspectives on the Environment

This chapter discusses major developments in the past year in government programs to protect the environment.

Energy

- "The major event affecting the pursuit of environmental quality over the past year was the energy crisis." (p. 93)
- "Energy conservation, which had been primarily of interest to environmentalists and certain energy-intensive industries in the past, emerged this year as a matter of major national importance." (p. 100)
- ". . . a rigid linkage between energy growth and economic growth is no longer accepted as self-evident, and the importance of energy demand management in future energy planning is now broadly recognized. . . . To the extent that economic and social goals can be achieved with lower levels of energy use, the environment will benefit." (p. 105)
- "Domestic production of petroleum liquids reached a peak in 1970, and it remains to be seen whether increased exploration (in response to higher prices) will lead to substantially increased supplies of new oil. Some geologists believe that U.S. oil production levels will not significantly increase above today's level." (p. 105)
- "Nuclear power continued to expand rapidly in the past year. Nine new nuclear units began operation in 1973, increasing nuclear electrical generating capacity to over 20,000 megawatts, or over 5 percent of the Nation's total electric capacity. For the decade ahead, over 150 additional nuclear units are under construction or planned, representing an additional 150,000 megawatts." (p. 109)

- "Both the economic and technical viability of solar energy moved strongly ahead during the past year. The environmental benefits of capturing the sun's energy have been recognized for some time; with much higher prices of oil, the economic differential between solar heating and cooling systems and conventional fossil fuel systems was markedly reduced." (p. 111)
- ". . . coal is our most abundant fossil fuel. . . . Success of Project Independence depends largely on the ability to use massive quantities of coal in place of imported oil. This may require expanding U.S. coal production and use to 1.2 to 1.8 billion tons per year by 1985. To accomplish this, major problems—many of which are environmental—will have to be overcome." (p. 112)

Air Quality

- "During the past year, as a result of the Arab oil boycott, the primary concern became the interrelationship between the pursuit of clean air and the provision of energy. In some respects, the energy crisis was supportive of improved air quality; in other cases, the two goals were conflicting." (p. 117)
- ". . . efforts during the Arab boycott were highly successful in protecting the environment in the face of considerable uncertainty about possible energy conditions. With the enactment of the Energy Supply and Environmental Coordination Act of 1974, EPA was granted broader authority to temporarily suspend fuel or emission limitations, should a similar emergency develop in the future." (p. 121)
- "For the longer term, the Arab boycott made clear that the United States must move towards the capability of self-sufficiency in energy. This capability, in turn, would require greater future use of coal with both low and high sulfur content. The policy problem was to permit increased use of coal without violating ambient air quality standards." (p. 121)
- "The adequacy of flue gas desulfurization systems, known as stack gas scrubbers, is one point of controversy. This technology permits high or medium sulfur fuels to be burned, with removal of the sulfur after combustion but before emission to the atmosphere. . . . A large fraction of the U.S. utility industry holds that scrubber technology is not sufficiently developed and is resisting a commitment to this technology." (p. 122)
- "In March 1974 an amendment to permit indefinite use of intermittent control systems was transmitted to the Congress by EPA but not supported by it. The Congress did not hold hearings on the proposal." (p. 123)
- "Tests of prototype vehicles indicate that 1975 cars can be expected to have better fuel economy than 1974 models due to the use of the catalytic converter rather than spark retard as a means for controlling HC and CO emissions. The use of the catalyst will permit the engine to be tuned for better economy rather than reduced emissions, with the catalyst oxidizing the unburned HC and CO to harmless CO_2." (p. 128)
- "The future of the nondegradation issue is as yet unresolved. EPA expects that any forthcoming regulations may be challenged in court, and Congressional review of the proposed amendment [to the Clean Air Act] has not yet taken place." (p. 131)

Solid Waste

- ". . . market forces are now activated which promise simultaneously to reduce the problem of disposing of solid wastes and to provide needed resources in the form of energy as well as reusable raw materials." (p. 131)
- "The technology for controlling hazardous waste disposal exists for most substances. However, since adequate treatment and disposal can be 10 to 40 times more expensive than environmentally unacceptable methods, improvement is not likely until legislation and regulation compels it." (p. 139)

Water Quality

- "During the past year, the difficult process of implementing [the Federal Water Pollution Control Amendments of 1972] moved forward. The new law required fundamental changes in approach by all institutions involved in water pollution control—Federal, state, and local governments and private industry—and in some areas the deadlines established by the law could not be met. Nevertheless, considerable progress was achieved, and the groundwork was established for more rapid forward progress in the immediate future." (p. 139)
- "The issuance of permits to 'point source' dischargers is the law's basic regulatory mechanism. At the same time, it is an enormous and complex task." (p. 143)
- "More disturbingly, the report also showed that as a result of growth, the amount of BOD_5 discharged by municipal treatment plants has remained almost constant since 1957." (p. 144)
- "In point of fact, commitment of funds has not to date been much affected by the impoundment because a number of new requirements in the Act, which are discussed below, have had the effect of slowing down obligations. Shortages of some materials such as steel have also hindered progress." (p. 146)
- "The control of non-point pollution is likely to become a major priority for water pollution control in the late 1970's and early 1980's, after pollution from point sources has been alleviated. EPA is taking steps to prepare for this effort." (p. 148)
- "Implementation of the permit program resulted in changes in [ocean] dumping practices. For example, EPA required the city of Philadelphia to move its sludge dump site 36 miles further out into the Atlantic as an interim measure while it develops an alternative method of disposal. Some 40 dumpers of industrial waste in the New York City area ceased dumping because of regulatory restrictions." (p. 149)

Hazardous Pollutants

- "Thousands of man-made chemicals are introduced into the environment each year, many for the first time. Of this myriad, a few have potential for causing very serious damage to man or the environment. . . . Urgently needed Federal authority to deal with toxic substances has been proposed by the President but has yet to be enacted by the Congress." (p. 151)
- "In June 1973, EPA announced the discovery of amosite asbestos fibers in the drinking water of Duluth, Minnesota, and nearby communities. . . . The primary health concern is that asbestos, a carcinogen which causes a variety of cancers (including gastrointestinal cancer)

when inhaled, will also cause cancer when ingested. Epidemiological and clinical studies of the Duluth population cannot provide a clear answer because the average period from initial exposure to the first symptoms of asbestos-induced cancer is 20–40 years. Yet when sufficient time has lapsed to make definitive conclusions, the fate of those who have drunk the contaminated water over the past 18 years may have been sealed." (p. 152)

- "Because of the large number of workers who have been involved with vinyl chloride over the last 15 years and because the general population has also been exposed to some degree, the 19 reported cases [of liver cancer] may be merely the first indication of a much larger environmental and occupational health problem, particularly since 15 years is less than the normal period of time required for cancer symptoms to develop." (p. 154)
- "On December 6, 1973, EPA promulgated regulations limiting the lead content of gasoline. . . . The regulation was based in part upon the need for non-leaded gas to avoid poisoning air pollution catalysts . . . but it will also reduce the introduction of lead into the environment from the combustion of gasoline, which is the most significant and controllable source of lead exposure." (p. 155)
- "The workplace is the portion of man's environment in which problems with hazardous substances are often first apparent and in which their health impact is often most severe." (p. 156)

Noise

- "The report [required by the Noise Control Act] estimated that 16 million people are presently exposed to aircraft noise levels with effects ranging from moderate to very severe. Although some noise reduction has been accomplished, EPA concluded that '. . . it appears that existing FAA flight and operational controls do not adequately protect the public health and welfare from aircraft noise.' " (p. 167)
- "In July 1973, EPA issued [a report entitled] *Public Health and Welfare Criteria for Noise*. The report affirmed that exposure to high levels of noise is potentially detrimental to work performance and efficiency and to human health, and that hearing loss from noise can be suffered not only by workers in noisy occupations but also by the general population as a result of environmental noise." (p. 170)

Pollution Control at Federal Facilities

- "The efforts of the Federal Government to keep its own environmental house in order are one important yardstick of its commitment to protect the environment. Funding for the control of pollution frm Federal facilities has increased steadily during recent years, from $115.7 million in 1971 to an expected outlay of $392 million in fiscal 1975." (p. 171)

Costs of Pollution Abatement

- "Every year the Council estimates the abatement costs associated with current environmental programs. . . . The Nation is expected to spend $194.8 billion from 1973 through 1982 for environmental improvement as a result of Federal environmental legislation. Although this estimate is almost one-third higher than last year's, the ratio of current and projected costs to the Gross National Product varies from 0.7 percent (1973) to slightly over 1 percent through the remainder of the decade." (p. 173)

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- "Approximately one-fourth of the increase in estimated costs over last year's estimate is explained by inflation. . . . Another one-half of the increase results from shifting the period from 1972–81 . . . to 1973–82, [a shift by which] a relatively high-cost year (1982, which comes at the end of the clean-up process) is added, while a relatively low-cost year (1972, which came before many expenditures actually were made) is dropped. The remaining one-quarter of the estimated cost increase is a net increase in real costs." (p. 174)
- ". . . the average cost per person in the United States was $35 to $40 in 1973. This will increase to approximately $80 in 1976 and then fall off. The 1976 costs are expected to be about 2 percent of the median family income." (p. 177)
- "During the past year, there is little evidence that environmental expenditures contributed in any significant way to the country's inflation. Less than one-half of 1 percent of the inflation rate could reasonably be attributed to pollution control. This inflationary impact is expected to become somewhat worse in 1976 and 1977 but still be in the range of 1 to 2 percent." (p. 178)

Protecting Our Natural Heritage

- ". . . most wildlife effort is still concentrated on a few game species—which represent a small fraction of the Nation's 400 species and subspecies of mammals and 800 species of birds—and is still financed by licenses and taxes on sporting goods paid by hunters and fishermen, who make up a small percentage of the population." (p. 179)
- "Recent years have brought an increasing recognition of a broad spectrum of wildlife values other than the harvest of a shootable or fishable surplus." (p. 179)
- "The greatest disturbance to wildlife is alteration of habitat by man. In some cases, man's activities benefit certain types of wildlife. For other types, loss or degradation of habitat poses a fundamental threat to continued existence. Agriculture and forestry practices provide striking examples of varied effects of human actions." (p. 182)
- "Native wildlife has been threatened by introduced species. . . . Agriculture has suffered . . . many cases of human injury or illness have been traced to exotic species, for such species often carry diseases or serve as hosts for parasites that affect man." (p. 185)
- ". . . the President in 1972 issued an Executive Order barring the use of poisons, except in emergency situations, for predator control on public lands and in Federal programs. . . . The basis of the new policy was to control those individual predators causing damage rather than attempting to reduce or eliminate whole predator populations. . . . The first full year of control without poisons ended in December 1973. Data indicate that the new approaches are at least as effective—in terms of both predators killed and livestock protected—as control measures based on poisons." (p. 187)
- "The Alaskan Native Claims Supplement Act became law in December 1971. Among other things, the Act called for a 2-year study leading to specific proposals for additions to the 'four systems,' National Parks, National Forests, Wildlife Refuges, and the Wild and Scenic Rivers System. This study was completed in December 1973, and the results proposed to Congress in legislation which would affect the disposition of almost 25 percent of the state's area." (p. 191)
- ". . . coastal zones in general, and estuaries and tidal marshes in particular, are increasingly threatened by human activities. Land filling

and development place great pressures on these areas. In the past 20 years, California alone has lost 67 percent of its coastal estuarine habitats in the process of coastal development." (p. 204)

- "In 1974, the Department of Agriculture promulgated its first regulations governing surface use of National Forest lands by persons operating under the 1872 mining laws. . . . The new regulations comply with the requirements of NEPA. They are intended to provide for reasonable protection of surface resources and the environment, while at the same time encouraging the minerals industry in responsible use of National Forest lands for the benefit of the national economy." (p. 206)
- "ORV use continues to grow at a rapid rate . . . more than 5 million ORVs are in operation in the United States today. . . . When misused, ORVs damage soil and destroy vegetation, disturb wildlife, destroy wildlife habitat, bring noise, litter, and vandalism to previously remote areas, and seriously disrupt other types of recreation." (p. 209)

3. Environmental Conditions and Trends

This chapter provides information about the condition of the environment and important trends in environmental quality. A section containing basic environmental statistical data is provided for the first time.

Population

- "Growth in world population is one of the fundamental factors shaping the quality of life on earth." (p. 239)
- "The 'population explosion' contains a built-in momentum, for as long as growth rates are above the replacement level (2.1 children per couple), a population will continue to grow. Even after the replacement level is reached, a population will continue to increase significantly for another 50 to 100 years." (p. 241)
- "To achieve the demographic transition that took place in the industrialized nations requires the developing countries to face a major task—to lower birth rates so as to match the lowered death rates. The experience of the developed nations suggests that the process of economic development is important in achieving this transition." (p. 244)
- "By the year 2000, about 51 percent of the world's population (81 percent in developed countries, 43 percent in developing countries) is expected to live in urban regions. . . . Furthermore, this growth in urban population is concentrating in large cities." (p. 246)
- "If the annual population growth rate for the United States remains at its present level, it will take about 97 years for the population to double itself; by the year 2000, the U.S. population would be approximately 250 million." (p. 250)
- [illegible]veral nations have shown that birth rates can be substantially re[illegible]ced, giving credibility to the goals that are being established." (p. [illegible])

- ". . . worldwide expenditures for research on fertility control are well below $100 million per year—only 10 percent of what the U.S. Government spends on cancer research alone." (p. 256)

Air Quality

- "During the past year, EPA completed a major evaluation of data on nationwide trends in air quality and emissions over the period 1940–72. . . . some improvements in the Nation's urban air quality have been achieved in recent years. Occurrences of poor air quality are still commonly observed, however, and worsening trends have been noted in some areas." (p. 257)
- "During the 1960's, average ambient TSP [Total Suspended Particulates] levels in urban areas reportedly declined on the order of 25 percent." (p. 262)
- "In spite of increased nationwide emissions, ambient SO_2 levels in urban air have reportedly declined more than 50 percent since the mid-1960's . . ." (p. 267)
- ". . . preliminary reports from New York City and Portland, Oregon, suggest that ambient carbon monoxide (CO) levels in the center city were reduced during the most severe months (winter, 1973–74) of the recent gasoline shortage." (p. 277)
- ". . . Philadelphia has reported that a marked upward trend in ambient sulfur dioxide (SO_2) occurred soon after a number of fuel sulfur variances were granted in the winter of 1973–74." (p. 278)

Water Quality

- "In summary, the EPA study [of water quality] provides a mixed picture regarding trends . . . For oxygen demand and bacteria, progress is evident. With regard to nutrients, the disturbing trends reported in our 1972 Annual Report appear to have been confirmed. Still limited data on metals and pesticides also give cause for concern. These indications of trends should be interpreted with caution, but the findings with regard to increased nutrients are clear enough to indicate that this difficult problem requires increased attention." (p. 287)

Projecting the Generation of Pollution

- "In recent years the Nation had undertaken major programs with significant impacts upon the environment and the economy . . . very few analytical tools were available for rapid, systematic, and comprehensive assessment of the impact of such programs . . . in the past, several analytical tools had been developed which facilitate such assessments." (p. 290)
- "By varying the assumptions about such factors as labor force participation, economic growth, patterns of consumer demand, the implementation of pollution control programs, SEAS can be used to test the implications of assumptions about the future state of our economy and national environmental policies." (p. 292)
- "MERES is . . . a computerized data base permitting rapid and comprehensive analyses of the direct environmental effects of energy supply and use." (p. 298)

Minerals and Materials Resources

- ". . . supply and demand for minerals and materials are determi the dynamic interaction of physical availability, costs of prod availability of technology, and degree of substitutability." (p. 30

- "In 1950, the United States consumed 2 billion tons of new minerals and and materials, equivalent to 26,000 pounds per capita of population. By 1972 . . . about 4 billion tons (40,000 pound per capita) were consumed." (p. 312)
- ". . . it is a global fact of life that, so far as resources are concerned, there is an interdependence among nations that transcends national boundaries, economic and technical capabilities, or political ideologies." (p. 317)

Pesticides

- "Over a billion pounds of pesticides—insecticides, herbicides, and fungicides—are manufactured in the United States each year . . ." (p. 317)

Wildlife and Habitat

- "Our ability to recognize an endangered species has always depended as much on the status of our knowledge about that species as upon its actual endangered status." (p. 324)
- "The U.S. Fish and Wildlife Service has recognized for some time that approximately one-tenth (nearly 200 species) of the higher animals (mammals, birds, reptiles, amphibians, and fishes) in the United States are endangered. During the past two years, however . . . review[s have] indicated that approximately one-tenth (100 species) of the clams and one-tenth (200 species) of the snails in the United States also appear to be threatened. Moreover, other studies have found that approximately one-tenth of our North American plant species are also presently endangered." (p. 325)

Environmental Indices and Interpretive Techniques

- ". . . there is a critical need for accurate and timely information about environmental conditions and trends, in order that important decisions affecting environmental quality and natural resources can be made on the most informed basis possible. . . . The general public and many decisionmakers in government and industry . . . must be supplied with comprehensive assessments of the significance of these data on a timely basis, thereby enabling these individuals to appreciate the feasible options and the consequences of alternative decisions." (p. 331)
- "The presently unsatisfactory state of our development of environmental indices and other interpretive techniques has . . . been due both to the difficulties of the problem and to a cautious attitude of the Federal Government and the scientific community." (p. 333)

4. The National Environmental Policy Act

This chapter reviews the evolution of NEPA over its first five years, including the adoption of environmental impact statement requirements by the states and foreign countries.

Evolution of NEPA—The First Five Years

- "When the first 5 years of NEPA are examined, three broad stages of development are evident: an initial period, during which Federal agencies became aware of the Act; a transition period, in which agencies came to understand and adapt to its requirements; and the present period, in which NEPA is increasingly being integrated into the fabric of agencies' programs." (p. 372)
- "The years 1971 to 1973 placed particular strains on the AEC. The agency had to analyze the large number of plants in the licensing pipeline as well as new applications coming before it. But by mid-1974, the backlog had been surmounted and the changes required of the AEC regulatory program had been put into effect. The initial uncertainty and disruption had been overcome." (p. 378)
- ". . . NEPA has had a major impact on the Forest Service. The agency took a broad and positive view toward implementation of the Act, went far beyond a narrow concern with the Section 102 requirement, and integrated each step in the NEPA process—from initial environmental analysis through preparation of draft environmental statements, involvement of the public, analysis of comments, and preparation of final statements—into the planning and decisionmaking process." (p. 381)

Administrative Developments—1973–74

- "During this past year, many agencies engaged in a major effort to revise their procedures for the implementation of NEPA." (p. 381)
- ". . . in May 1974 EPA announced that it would voluntarily prepare impact statements on a variety of regulatory actions." (p. 388)
- "By June 30, 1974, four and a half years after NEPA was enacted, environmental impact statements had been prepared on 5,430 agency actions." (p. 388)

Judicial Developments—1973–74

- "In a number of significant judicial developments during the past year, the courts elaborated on the rights of citizen groups to be compensated for their expenses in bringing a NEPA lawsuit, on the relationship between NEPA and land use planning, on the extent to which an agency can delegate the preparation of a statement, and on the standards to be applied in assessing the adequacy of an impact statement." (p. 393)

International Developments

- "NEPA has had unique and important effects on the international community. That this domestic law should have such an impact testifies to its particularly broad administrative scope and to its conceptual strength. U.S. agencies have directly contributed to the Act's international importance and influence through their own NEPA processes. At the same time a number of other countries have recognized that adoption of the impact statement mechanism can fill critical needs for forecasting environmental effects." (p. 399)

State Environmental Impact Statement Requirements

- "Since 1970, 21 states and the Commonwealth of Puerto Rico have adopted environmental impact statement requirements similar to those set forth in NEPA." (p. 401)
- "Integration of a state EIS process into a state's decisionmaking will take some time. Apart from the problem of resource constraints, many states

have no tradition of providing detailed documentation and analysis to assist decisionmaking. Hence, the impact statement process has created uncertainties on the state level which do not exist at the Federal level." (p. 402)

Some Thoughts on the Future

- "Looking ahead at the next few years, the clearest and most probable major advance is likely to be in the quality of environmental analysis contained in impact statements." (p. 409)
- "Impact statements usually analyze the initial or primary effects of a project, but they very often ignore the secondary or induced effects. A new highway located in a rural area may directly cause increased air pollution as a primary effect. But the highway may also induce residential and industrial growth, which may in turn create substantial pressures on available water supplies, sewage treatment facilities, and so forth. For many projects, these secondary or induced effects may be more significant than the project's primary effects." (p. 410)
- ". . . an environmental analysis needs to be prepared as a rough approximation during the initial planning of a project and then gradually refined as the planning of the project proceeds and as alternatives are identified, analyzed, and perhaps discarded. In this way, the environmental analysis at each stage in the planning process is appropriate to the decisions to be made at that stage." (p. 411)
- "In the future, it seems possible that the size of impact statements will eventually decrease. As the relevance of different types of information becomes apparent, the current approach of some agencies simply to catalog an enormous variety of facts should slowly begin to change." (p. 412)
- "NEPA is alive and well. It has passed through a transition period, during which agencies have become aware of the Act's widespread requirements, and the basic structure of the environmental impact statement process has been firmly established. NEPA has emerged as an integral and essential part of all Federal agencies' activities." (p. 413)

5. A Global Environment

This chapter describes the development of the United Nations Environmental Program (UNEP) and, in the framework of its Action Plan, the broad range of international environmental efforts now underway around the globe. The chapter also describes recent international activities undertaken bilaterally or multilaterally outside of the United Nations framework.

- "[T]his year, with the second meeting of the Governing Council of the United Nations Environmental Program (UNEP), an integrated global approach to international environmental affairs has begun to take shape." (p. 427)

The UN Environmental Program and Environmental Fund

- "In the perception of developing countries, the major environmental problems relate to the lack of economic development. . . . The developed countries, in contrast, are more concerned about the impact of man on natural systems. . . . The Action Plan reflects the interests of both groups." (p. 432)
- "[World Population Year] is part of an effort to achieve worldwide awareness of population matters and to find a rational, workable balance between people and resources, so that the quality of human life everywhere can be improved through better knowledge, informed policy, and action." (p. 434)
- "Over the last year, world attention has been focused on drought in the Sahel, a strip of land stretching across Africa south of the Sahara Desert. . . . The drought-stricken area is as large as the continental United States, with a population of around 25 million. . . . Only in the past year have the enormity and consequences of the drought begun to be fully realized." (p. 437)
- "Whales, more than any other form of life, have come to symbolize the problems of managing and protecting living resources." (p. 442)
- "The major achievement of the [IMCO] Conference was to end the practice of large-scale discharge of oily water ballast from tankers." (p. 444)
- "The environmental significance of [The Law of the Sea] Conference, held in Caracas this summer, cannot be overemphasized." (p. 445)
- "Earthwatch is one of UNEP's major functional tasks. It is designed to provide a global environmental assessment so that decisions on the management of the environment are sound and rational." (p. 449)

Bilateral Cooperation

- "During the last year an environmental problem of great importance to Mexico and the United States moved toward resolution as the result of an agreement . . . on a 'Permanent and Definitive Solution to the International Problems of the Salinity of the Colorado River.'" (p. 453)
- "The United States and Canada are seeking mutually beneficial solutions to a number of environmental problems, ranging the length of the border from Puget Sound to the waters off Maine and New Brunswick." (p. 454)

Multilateral Cooperation

- "[The OECD] has developed an 'early warning system' to signal to other members actions taken in the environment that might significantly affect international trade. However, no clear cases of trade distortions attributable to differing environmental constraints or practices have been brought before the Committee." (p. 460)

Conclusion

- "This year's report has concentrated on the United Nations Environmental Program. The rapid development of this new organization is heartening. Its growth has encouraged nations in all stages of development to understand the need for environmental concern. UNEP is institutionalizing environmental concern on a global scale just as NEPA has done on a national scale in the United States." (p. 462)

6. CEQ Studies

This chapter provides brief descriptions of some of CEQ's analytical work over the past year.

OCS Oil and Gas—An Environmental Assessment

- "In his Energy Message to Congress on April 18, 1973, the President requested CEQ to undertake a 1-year study of the relative environmental risks of oil and gas development in the Atlantic and Gulf of Alaska outer continental shelves (OCS) and to suggest ways in which the risks might be minimized or prevented. The results of our study were presented to the President on April 18, 1974." (p. 467)
- "As a result of the study, CEQ developed a ranking of relative environmental risks (from least to greatest) that are associated with potential oil and gas operations in the Atlantic and Gulf of Alaska outer continental shelves." (p. 467)
- "CEQ recognized that risk of damage to the human and natural environment is an inseparable part of almost any development, including the OCS. When the risk is acceptable, the Council stated that we should proceed with caution and with a commitment to prevent or minimize damage. The guiding principles in initiating development in new OCS areas must be to keep the risks at an acceptable level and to balance risks with benefits." (p. 469)

The Half and Half Plan for Energy Conservation

- "To stimulate serious examination of the opportunities open to our Nation through energy conservation, CEQ in March developed the Half and Half Plan, calling for a serious long-term national program to conserve energy and meet the needs of a growing economy." (p. 475)
- "This target was based on growth in net per capita energy consumption of 0.7 percent per year and on a continuing conservation effort which would, through improved efficiency and elimination of waste, save energy at a rate of 0.7 percent per year. This program—half growth and half conservation—would provide an effective increase in usable energy of 1.4 percent per year, equal to the average rate of growth experienced from 1947 to 1972." (p. 475)

The MERES Energy Model

- "During the past year, CEQ co-sponsored the development of the MERES model, a detailed data base to facilitate evaluation of the environmental impacts from energy systems." (p. 476)
- "To understand the environmental impacts of [an energy] system requires a detailed examination of every step in the energy supply and end-use chain, and a characterization of each link with respect to environmental impact and energy efficiency." (p. 477)
- "The data contained in the MERES System are being placed in a computerized information retrieval system, and computer programs are being written which will allow rapid analysis of the environmental effects of energy systems." (p. 478)

Offshore Nuclear Power Plants

- "The siting of nuclear power plants offshore in the ocean is under consideration by several utilities . . . Because the offshore concept is

promising from several points of view, and because relatively little information and analysis were available, CEQ in the summer of 1973 initiated a major study to investigate the potential environmental effects." (p. 480)

Stormwater Runoff

- "The Enviro Control study documents the finding that runoff from storms contributes a major portion of the water pollution load in urban areas." (p. 481)
- "Planning for water pollution abatement must include analysis of the load contributed by runoff. . . . In many instances, such planning may show that abatement of pollution from runoff is more cost-effective than higher levels of point source treatment. Most importantly, this study shows that treatment of municipal and industrial discharges alone will generally not be sufficient to provide clean waters in urban areas." (p. 482)

Municipal Wastewater Treatment Alternatives

- "[The study presents] in a single volume the basic information necessary for a preliminary evaluation of 11 alternative municipal wastewater treatment technologies and 12 alternative sludge handling and disposal methods available today." (p. 483)
- "For each of these alternatives, the Battelle study provides detailed information on the environmental inputs (such as energy, concrete, steel, chemical, land, and labor), the environmental outputs (such as BOD, suspended solids, nutrients, heavy metals, atmospheric emissions, and sludges) and capital and operating costs." (p. 483)

Cross-Media Impact of Pollution Control

- "Pollution controls imposed to protect one environmental medium—the air, the water, or the land—can result in pollutant impacts on other media. . . . Sophisticated pollution control therefore requires the development of methodologies to define and evaluate the cross-media effects of different pollution control technologies." (p. 484)

Pollution Abatement Costs and the Distribution of Income

- "This study . . . analyzed the distribution across income levels of 'incremental' pollution abatement costs—those costs expected to be incurred to meet currently legislated standards beyond what would have been spent in the absence of Federal legislation—for air and water pollution control in 1972, 1976, and 1980." (p. 485)
- "The analysis indicates that, in the aggregate, costs are distributed somewhat regressively, at least up to the level of the median income family." (p. 485)

Pesticide Use

- "Excess application [of pesticides] occurs because it is difficult to predict pest outbreaks. Farmers, uncertain about when to use control measures, consider treatment a relatively inexpensive form of insurance." (p. 487)
- "The report recommends the development of a much more extensive information system . . . to offset the biased information distributed by pesticide manufacturers." (p. 487)

The Costs of Sprawl

- "The Council . . . recently published the results of a 1-year study of the economic, environmental, natural resource, and social effects of alternative residential (and commercial) development patterns on the urban fringe." (p. 488)
- "[T]he study results . . . show a surprising consistency: 'planning' to some extent, but higher densities to a much greater extent, result in lower economic costs, lower environmental costs, less consumption of natural resources, and a reduction in some personal costs for a given number of dwelling units." (p. 488)

Leisure Homes Study

- ". . . the study concludes that leisure homes are over time converted into permanent residences, and therefore should be viewed as a special form of early urbanization which generates the same types of economic, environmental, and social impacts as other residential developments." (p. 489)
- ". . . leisure home developments may create more serious environmental problems than most residential developments because they often take place where there are few effective land use controls and are often built to lower standards and in less suitable environments—for example, on mountainsides or in wetlands—than normal suburban subdivisions." (p. 489)

Secondary Effects of Transportation and Sewage Facilities

- "The second part of the study has involved the development of tools to be used by planners and reviewers of proposed investments in analyzing the degre of development expected to be stimulated by new transportation and sewer investments." (p. 490)

Fuel Economy Project

- "The major generalization to be derived from these studies is that changes in gasoline prices affect gasoline consumption in a predictable manner in the short run and in a much more significant manner in the longer term, and therefore that automobile fuel consumption should not be thought of as an insensitive demand growing unvaryingly from year to year. Over a period of time, rising gasoline prices induce consumers to demand smaller, more efficient vehicles. Manufacturers, in turn, respond rapidly by offering a greater selection of smaller cars and efficiency-improving innovations across their lines." (p. 491)

Ecosystems Models

- "Modeling of global and regional ecosystems is a new focus of intellectual inquiry and one which is highly complex. Construction of models requires vast amounts of data and careful validation and testing, and as yet their results can only be considered preliminary. But such models are promising tools for comprehending the complex interactions of global systems, and it is important that efforts to improve and validate them continue to go forward." (p. 494)

Preface

The Fifth Annual Report of the Council on Environmental Quality was prepared in accordance with the National Environmental Policy Act of 1969, Public Law 91–190, 42 U.S.C. 4321, which requires the Council to report at least once a year on the state of the environment and efforts to improve it.

The report discusses events up to August 1, 1974. References to the President therefore refer to Richard M. Nixon, who resigned office on August 9, 1974.

The Council welcomes comments on this report, especially suggestions for activities at the state and local levels of government and in the private sector. We would also appreciate comments on the report's presentation, including the appendices, footnote references, graphic material, and the like.

Although this report is the product of long and concerted efforts by the Council's staff and members and reflects excellent cooperation from Federal agencies, a number of individuals both inside and outside the Government deserve special gratitude and acknowledgment for their assistance. Special appreciation is due to: Martin Baughman and John Bell, Energy Laboratory of the Massachusetts Institute of Technology; William Cox, Robert Horn, Frederick Leutner, and Robert Nelligan of the Environmental Protection Agency; Howard Campbell, Marc Imlay, and Chandler Robbins of the Fish and Wildlife Service; J. Clarence Davies of Resources for the Future, Inc.; Murrey Goldberg and Walter Savian of Brookhaven National Laboratory; John Winters of the Indiana State Board of Health; and Susan Pondfield of the University of Pennsylvania. We are indebted to the Bureau of Economic Analysis, U.S. Department of Commerce, for permission to publish excerpts from an article from the *Survey of Current Business* which form Appendix 2 of Chapter 2 of this report. In particular we are grateful to Roma K. McNickle for her able and tireless efforts in preparing this report for publication.

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CHAPTER 1

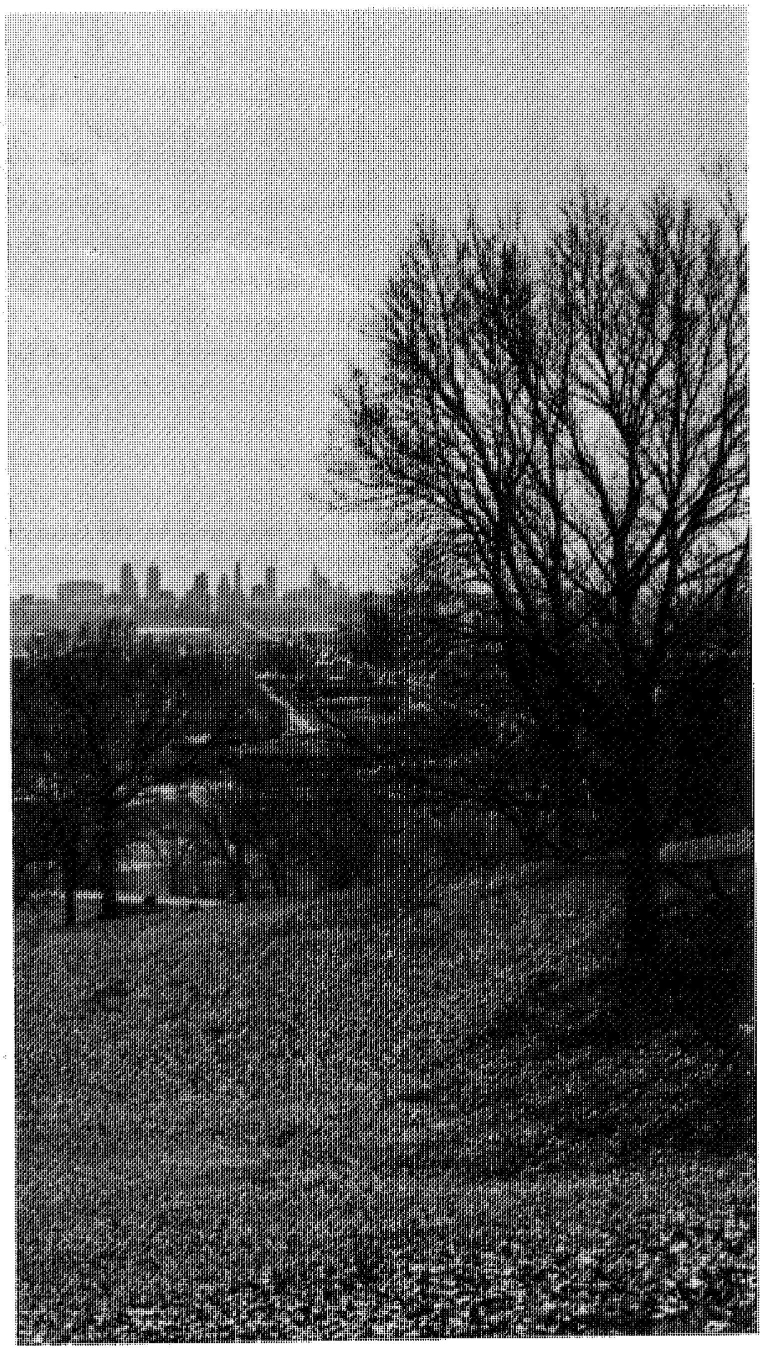
Land Use

To define and achieve good use of land may well be the most fundamental of all environmental objectives. In the broadest sense, the way in which we use our land determines the way in which our society functions. Land is the basic source of our food, fiber, shelter, water, and oxygen. Sound land use is fundamental to preserving stable ecosystems, to controlling pollution, and to creating the political, social, and economic structure of our society.

Land reflects our history and traditions; the values we place on its use show a great deal about what we cherish from our past. A debate over land use is a debate that quickly turns to basic rights of citizens and basic powers of government that must be accommodated under our Constitution. Land is seen as a measure of the wealth, power, and status of an individual in our society. Our present use of land reflects how we have thought about these things. How we permit changes in its use indicates the direction of our thinking today and tomorrow.

In the early years of environmental awakening in the late 1960's, land use was seldom treated as an issue on a par with air and water pollution or solid waste management. But all that has changed. A recent survey found that officials in American cities identify "land use" and "growth" as the two most serious environmental problems.[1] Similar concern is reflected in increasing citizen involvement in deciding how land will be used, and manifested by the many local land use and land development referenda. Finally, this concern is expressed by the increasing number of local, state, and Federal laws and regulations which explicitly recognize the need for improved evaluation of and control over land use.

But the issue of proper land use is as complex as it is fundamental. An attempt to control pollution may stimulate land use changes that result in the creation of more pollution. Efforts to control growth and sprawl in one place may stimulate worse sprawl in another. An under-



The way we use our land reflects the values and traditions of our society.

standing of land use requires an understanding of law, economics, sociology, ecology, and many other disciplines.

This chapter attempts to deal with some of these complexities by compiling and analyzing current knowledge about a number of important land use issues. It is not an attempt to provide a comprehensive analysis of how all the pieces fit together, but neither does it approach the subject from a strictly legal, or economic, or social, or ecological viewpoint.

The subject of land use includes a broad range of topics—from redevelopment in cities to strip mine reclamation and wilderness preservation. We have decided to focus on those places where development and land use changes are most intense—the urban fringe of our cities and those rural areas being impacted by the boom in leisure homes and recreational developments. While this selection may seem to ignore other areas where land use problems exist, conditions there are different more in degree than in kind, and the same principles and interrelationships apply everywhere.

The chapter is organized into several sections. "Effects of Development" summarizes what is known about the environmental, economic, social, and natural resource implications of land development, documenting the importance of the land use issue. The next section analyzes some of the stimulants to land development, particularly those that result from actions by the Federal Government. There follows an analysis of some of the tools available to control the impacts of land use stimulants and to mitigate unfavorable impacts from land development. The conclusion discusses how all these perspectives and considerations fit together and suggests some changes that might improve the effectiveness of land use planning and control.

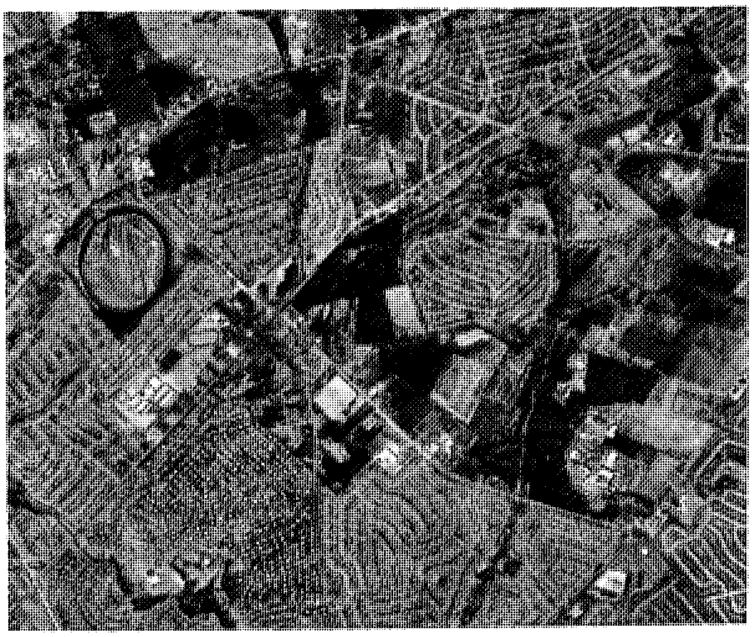
Effects of Development

More and more people are recognizing that land use—good or bad—affects a wide spectrum of environmental, economic, social, and political concerns. In many cases these effects can be essentially irreversible. Until recently, very little information has been available on how significant the various effects are. The purpose of this section is to summarize some of the most recent information available on this question.

Development in Metropolitan Areas

Urbanization and suburbanization have been the predominant characteristics of population shifts in the United States over the past two decades. Approximately 70 percent of all Americans live in metropolitan areas, and over half of those in the suburbs alone.[2] While the population of central cities increased 5 percent in the 1960's,

We are just now beginning to understand the process of urban development. These photos show what occurred in one area of the Philadelphia metropolitan area over the period of a few years in the 1950's.



that of the suburbs increased by 28 percent (see Table 1). This population shift resulted in a 31 percent increase in the number of dwelling units in suburban areas. As a result, 35 million acres of land is now in urbanized areas (see Table 2), and from 1960 to 1970 over 2,000 acres a day shifted from rural to urban use. Much of this development has taken place in an uncoordinated, scattered fashion which leaves many parcels of vacant land within urbanized areas.[3] Owing to this "leapfrogging" and the fact that the single family house has been the most common type of dwelling unit, the population density

Table 1

U.S. Suburban Population and Housing, 1960 and 1970

[In millions]

	1960	1970	Percent change[1]
Total metropolitan areas			
Population	120	139	17
Housing units	39	46	20
Central cities			
Population	61	64	5
Housing units	20	23	11
Suburbs			
Population	59	76	28
Housing units	18	24	31

[1] Percentages may be inconsistent with previous columns due to rounding.

Source: U.S. Bureau of the Census, *Census of Population and Housing: 1970, General Demographic Trends for Metropolitan Areas, 1960 to 1970,* Final Report (Washington: U.S. Government Printing Office, 1971), p. 1-33 and p. 15.

Table 2

Selected Uses of U.S. Land, 1959 and 1969

[In millions of acres]

	Special uses		
	1959	1969	Change
Urban areas[1]	27.2	34.6	7.3
Transportation areas[2]	24.7	26.0	1.3
Recreation and wildlife areas[3]	61.5	81.4	19.9
Public installations and facilities[4]	27.5	27.4	−.1
Farmsteads and farm roads	10.1	8.4	−1.7
Total	**151.0**	**177.8**	**26.8**

[1] Includes urbanized areas as defined by the Bureau of the Census, and other incorporated and unincorporated places of 1,000 or more population.
[2] Rural land in highway, road, and railroad rights-of-way, and airports.
[3] Federal and state parks and related recreation areas and Federal and state wildlife refuges.
[4] Federal land used for national defense and atomic energy purposes and state land in institutional sites and miscellaneous other uses.

Source: U.S. Department of Agriculture, Economic Research Service, *Major Uses of Land in the United States: Summary for 1969,* Agricultural Economics Report Number 247 (Washington: U.S. Government Printing Office, 1973).

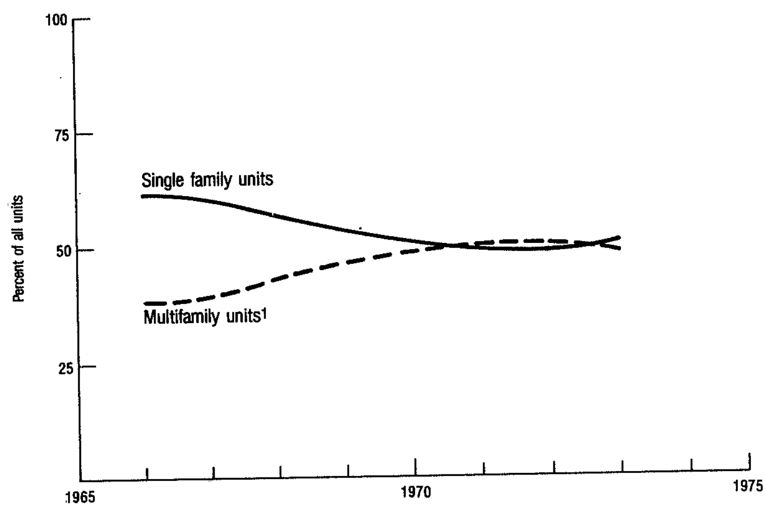
in our newly developed areas has typically been low. These and other land use trends were documented in our Fourth Annual Report.[4]

However, the most recent pattern of urbanization has not been as uniform as the averages might suggest. Subdivisions, more than ever, are likely to differ substantially from one another. One might be a traditional single family home subdivision, a second a high density development with townhouses and highrise apartments. As Figure 1 indicates, multifamily housing is becoming increasingly popular in the suburbs, first exceeding 50 percent of all suburban housing units constructed in the Nation in 1971.

While development patterns have been changing, local officials and the public have become more concerned about the economic, environmental, and social costs associated with the urbanization process. High taxes to pay for services to new residents, congestion, silted streams, polluted air, and the destruction of unprotected open space and natural features are all common characteristics of many of our suburban areas. More and more people are becoming concerned about these costs and are beginning to take a hard look at each new development proposal in their communities. At the same time, little information is available about the actual magnitude of these costs and how they vary among alternative development types.

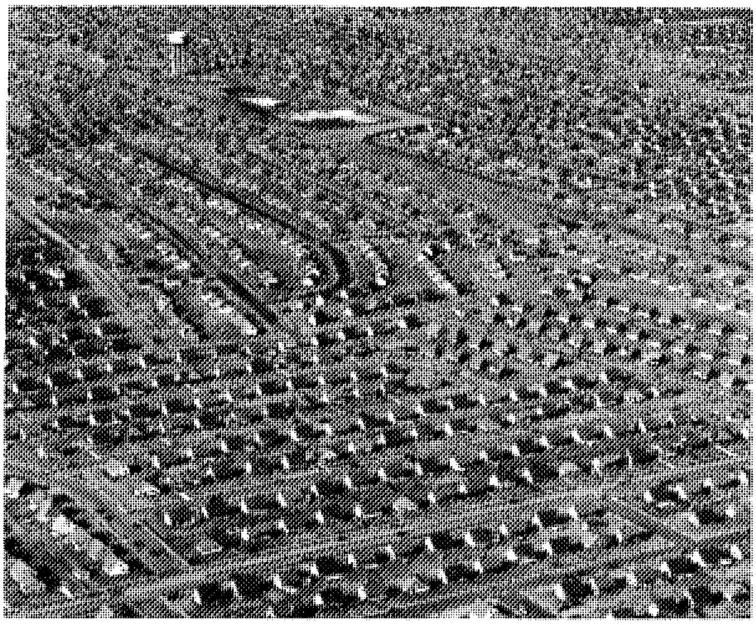
This year the Council on Environmental Quality, in association with the Department of Housing and Urban Development and the Environmental Protection Agency, published a study, *The Costs of*

Figure 1
Housing Starts in Metropolitan Areas Outside Central Cities



[1]Multifamily units have two or more dwelling units per building.

Source: U.S. Bureau of the Census, *Housing Authorized by Building Permits and Public Contracts*, Various Issues.



One important recent trend is the shift in new development from single family homes on individual lots to clustered and multi-family units surrounded by public open space. These photos show Levittown, Long Island, soon after it was built over 20 years ago, and a modern development of suburban townhouses.

Table 3

Types of Costs Analyzed

Economic Costs (capital and operating)	Environmental Effects
Residential (capital only)	Air Pollution
Open Space/Recreation	Water Pollution, Erosion
Schools	Noise
Streets and Roads	Vegetation and Wildlife
Utilities (sewer, water, storm drainage, gas, electric, telephone)	Visual Effects
Public Facilities and Services (police, fire, solid waste collection, library, health care, churches, general government)	Water and Energy Consumption
Land	Personal Effects
	Use of Discretionary Time
	Psychic Costs
	Travel Time
	Traffic Accidents
	Crime

Sprawl, which for the first time documents many of these costs and estimates how they vary among different patterns of land development.[5] The study, oriented toward new housing developments on the fringe of urban areas, considers a wide range of economic, environmental and social effects (see Table 3) associated with alternative development patterns on both the neighborhood and the community level. The results discussed below refer to two types of prototype communities, defined as follows:

"Low density sprawl"—A community made up of detached single family homes, 75 percent sited in a traditional grid pattern and the rest clustered. Neighborhoods are sited in a "leapfrog" pattern with little contiguity.

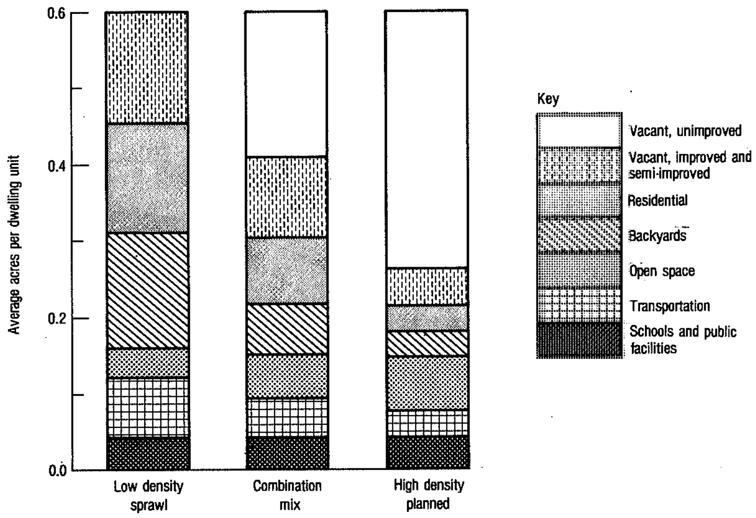
"High density planned"—A community composed of 40 percent 6-story highrise apartments, 30 percent walkup apartments, 20 percent townhouses, and 10 percent clustered single family homes. All of the dwelling units are clustered in contiguous neighborhoods, much in the pattern of a high density "new community."

In addition, an intermediate pattern including both traditional subdivisions and more clustered developments and in many suburban areas, entitled "combination mix," is included in the figures for illustrative purposes. The following sections summarize the results of the study.

Land Use—As indicated above, urbanization consumes significant amounts of land, much of it valuable for agriculture or wildlife. *The Costs of Sprawl* study shows that even with quarter-acre lots, the low density sprawl community may consume over one-half an acre per dwelling unit, more than twice as much land as the high density planned community. In the low density community, much of the land has been provided with such infrastructure as roads and sewers but has been left vacant. This category of land, "vacant, improved, and semi-improved," is an indication of the amount of leapfrogging and waste of land that occurs within a development pattern.

Figure 2

Community Land Use



Source: Real Estate Research Corporation, *The Costs of Sprawl: Executive Summary* (Washington, D.C.: U.S. Government Printing Office, 1974), p.3. Referred to by title in subsequent figures.

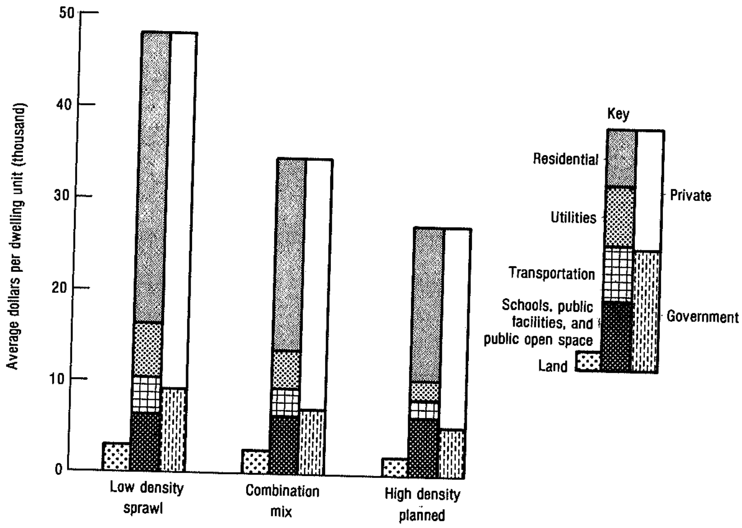
Figure 2, shows the amount of land assumed to be used for different purposes in the different community types.

Although four times as much land is used for residential purposes in the low density sprawl community as in the high density planned community, only two-thirds as much is dedicated to public open space. (Note, however, that if backyards are included, the low density sprawl community has twice as much as public *and private* land dedicated to open space as the high density planned community.) The amount of land used for schools and other public buildings is the same in all communities. However, the high density community uses only about half as much land for transportation as the low density community.

Economic Costs—Any type of land development is expensive, but there is substantial evidence that the economic costs are strongly affected by development patterns. In terms of total public and private investment cost to occupants, taxpayers, and municipal governments, the *Costs of Sprawl* study found that the high density planned community costs 21 percent less than the combination mix community and 44 percent less than the low density sprawl community. The largest savings are in the cost of constructing residential dwellings, although important savings are also attributable to reduced

Figure 3

Community Cost Analysis Capital Costs



Source: *The Costs of Sprawl, Executive Summary*, p.3.

costs for roads and utilities (about 55 percent lower in the high density than in the low density community).

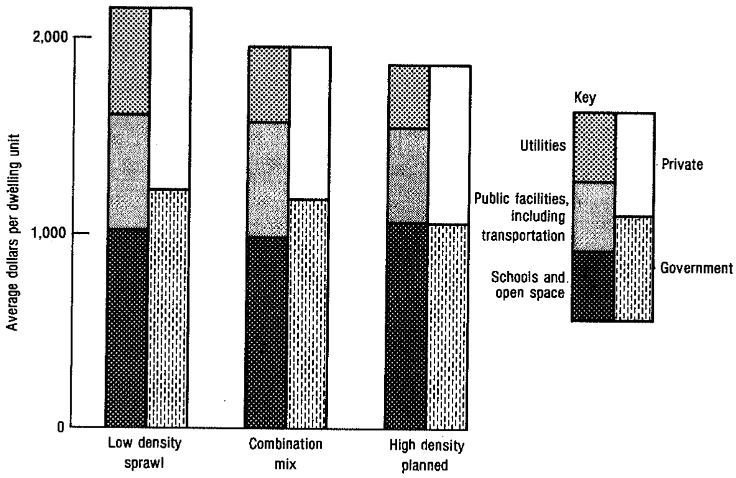
Figures 3 and 4 summarize the investment and operating costs for the three communities and show once again that sprawl is the most costly development pattern. The total investment costs do not include the cost of the land; that is indicated separately in Figure 3. Figure 3 also shows the difference in investment costs which are borne privately (initially by the developer) and publicly. Not only does the high density planned community cost less to construct, but a lower proportion of the development cost is likely to be borne by government.

The difference in operating and maintenance (O&M) costs (see Figure 4) is less noticeable than the difference in investment costs because O&M costs are related more closely to the population served than to the pattern of development. However, the higher density communities are again somewhat less costly in terms of the total operating and maintenance costs and in the costs paid by government.[6]

Many of the conclusions reached in this community level analysis are applicable to an entire metropolitan area. Planning and increased density can reduce costs. This is borne out by results of a well-known analysis of the economic implications of the new town of Columbia, Maryland, summarized in Figure 5. The analysis was concerned with alternative development patterns in Howard County, which

Figure 4

Community Cost Analysis
Annual Operating and Maintenance Costs



Source: *The Costs of Sprawl, Executive Summary*, p.4.

lies southwest of Baltimore. Three development patterns were analyzed: (1) random growth along the sprawl patterns which had already begun; (2) concentrated development in a new planned city; and (3) a new planned city in association with continued random growth. Continued sprawl was significantly more expensive than either of the alternatives.

A 1968 study of the San Francisco region focused on the other side of the urbanization process, namely the cost of preserving open space.[7] Using a housing location and land use model, the study investigated the implications in terms of settlement patterns and economic costs of preserving large tracts as open space, with all anticipated development occurring in unpreserved areas.

The results of the study indicated that such large-scale land preservation might well make sense economically as well as environmentally. The purchase price of open space actually exceeded by savings in public facility costs that derived from more compact development.[8]

These and other studies indicate that there may well be substantial cost savings involved in exerting more community control over the type of development and the pattern of urbanization.[9] The possibility of such savings has stimulated cities such as San Diego, California, and Boulder, Colorado, to seriously analyze their long-

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The *Costs of Sprawl* study shows that leapfrog subdivision patterns such as that shown here are significantly more costly to communities than carefully planned extensions into undeveloped areas immediately adjacent to already urbanized areas.

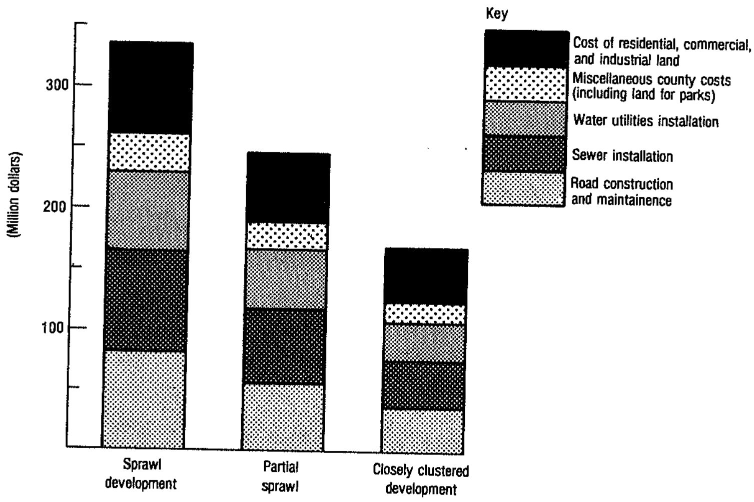
term growth options and the associated economic implications.[10] We can expect to see this trend continue.

Environmental Costs—Urbanization also generates substantial environmental costs. One of the Nation's most difficult problems, for instance, is the control of air pollution in our urban areas. *The Costs of Sprawl* analyzed air pollution from two major sources: automobiles and residential heating. Here again, the amount of air pollution is strongly affected by the development pattern. Higher density development requires less energy for heating, and high density and well-planned communities require considerably less automobile use. Overall, the high density planned community generates about 45 percent less air pollution than the low density sprawl community housing the same number of people (Figure 6). The simple clustering of houses alone can reduce the amount of air pollution from automobiles by 20 to 30 percent.[11]

On the metropolitan area scale, several recent studies have also indicated that air pollution can be affected by broader patterns of urbanization. There is, for instance, a strong relationship between automobile use—and therefore pollution emissions—and land use and urban form.[12] Urban form can also affect the way in which pollutants disperse, thus affecting air quality even beyond any impact on the quantity of pollutants emitted.[13]

Figure 5

Howard County, Maryland: Land and Public Service Costs for Alternative Development Patterns[1]



[1]Cumulative costs from 1965 to 1985.
Source: Howard County Planning Commission, *Howard County: 1985* (1967).

With respect to the problem of water pollution, several studies have documented adverse impacts on water quality from land development, quite aside from the generation of wastewater by new residential or industrial development. Urbanization, for example, results in substantially increased amounts of stormwater runoff, which leads to high pollution loads and erosion of exposed soil.

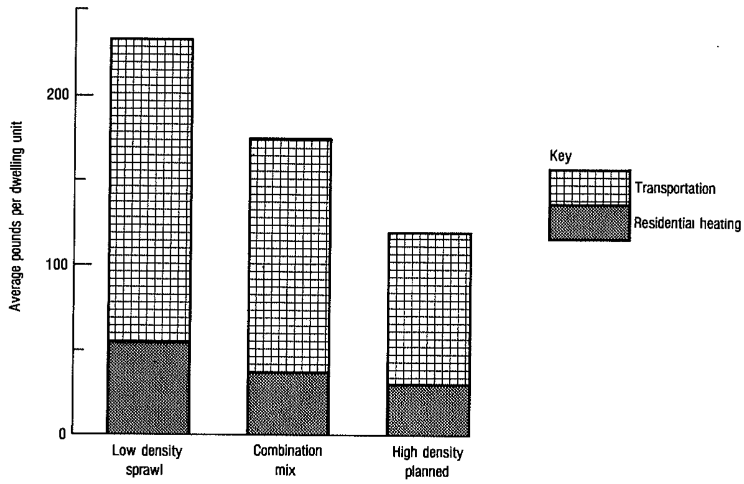
A recent study undertaken for the Council on Environmental Quality [14] indicates that stormwater runoff is a major source of water pollution in urban areas. Comparing stormwater runoff with wastes processed by municipal sewage treatment plants, runoff becomes the major source of pollution in most cities as soon as secondary treatment (85 percent BOD removal) of municipal wastes is achieved. It will also be the major source of settleable solids, pathogens, and bacteria and a major contributor of such toxic pollutants as lead and mercury.

Figure 7 shows water pollutants generated by different community development patterns. The type of housing has no effect on the amount of sanitary sewage generated, since this is a function of population.[15] More pavement and less vegetation result in increased stormwater runoff, and soil erosion will occur.

Air and water pollution are not the only environmental problems associated with urbanization. Noise caused primarily by air and

Figure 6

Community Cost Analysis
Annual Air Pollution Emissions



Source: *The Costs of Sprawl: Executive Summary*, p.4.

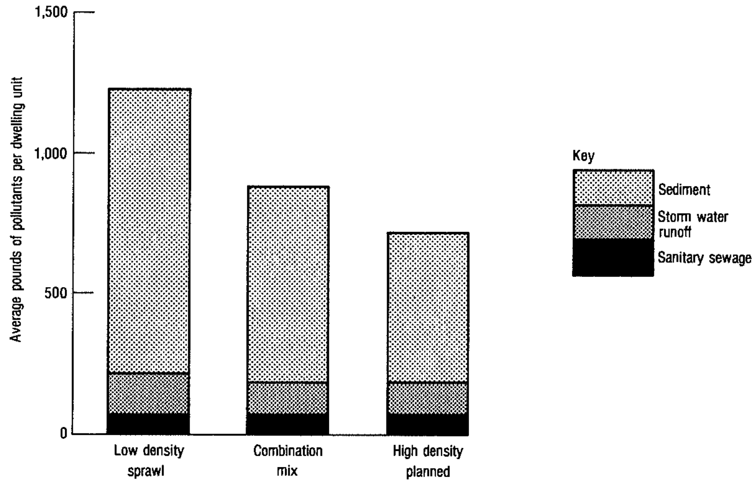
highway transportation is difficult to abate, although its impacts can be reduced by providing for compatible land uses.[16] Proper planning is also the key to conserving open space and preserving unique natural areas as well as creating visually attractive development.

Higher densities provide the planner with greater opportunity to mitigate many of the environmental costs associated with development. However, increased density also concentrates noise-generating activities and puts added demands on the designer to create aesthetically pleasing environments. It is also true that higher densities, although generating less air and water pollution per dwelling unit, concentrate these emissions in a smaller area. This results in a somewhat higher amount of pollution generated for a given developed area.

Similar environmental effects are related to the urbanization pattern for the broader metropolitan area. A general compactness of development results in lower pollution levels. One recent study compared U.S. urban areas which tended to have a high orientation towards the central city (typically with high core city densities and a radial transportation network) with other more dispersed U.S. urban areas.[17] The former have more intensive use of land overall, lower percentages of land devoted to residential and commercial development, more open space, and better opportunities

Figure 7

Community Cost Analysis
Annual Water Pollution Generation



Source: *The Costs of Sprawl: Executive Summary*, p.5.

to abate air and water pollution. The study goes on to conclude, "All trends point in the same direction: increasing size, increasing dispersion, and increasing automobile usage are producing the very urban forms and land use patterns that will increase rather than decrease environmental pollution." [18]

Energy Costs—Urbanization in its various forms can also affect the demands placed on energy and other scarce natural resources. Over half of our total energy consumption occurs in the transportation and residential sectors, both of which are significantly affected by housing types and development patterns. The interrelationships between energy consumption and development begin at the design and construction of the individual building and continue through the whole pattern of metropolitan area development.

The amount of energy consumed by stoves, appliances, and lighting is essentially constant among housing types, any variation being related to different family sizes or to different floor areas. However, the major source of energy consumption is in cooling and heating the house, and this is affected by the type of dwelling unit. Highrise apartments are estimated to consume about 44 percent less energy per dwelling unit for all "residential" purposes than detached single family houses. (See Figure 8.)

Poor planning and inadequate controls on urban fringe development can be costly to the community and to the natural environment. The photos show the effects of erosion, runoff, and sedimentation in Nebraska and Maryland.

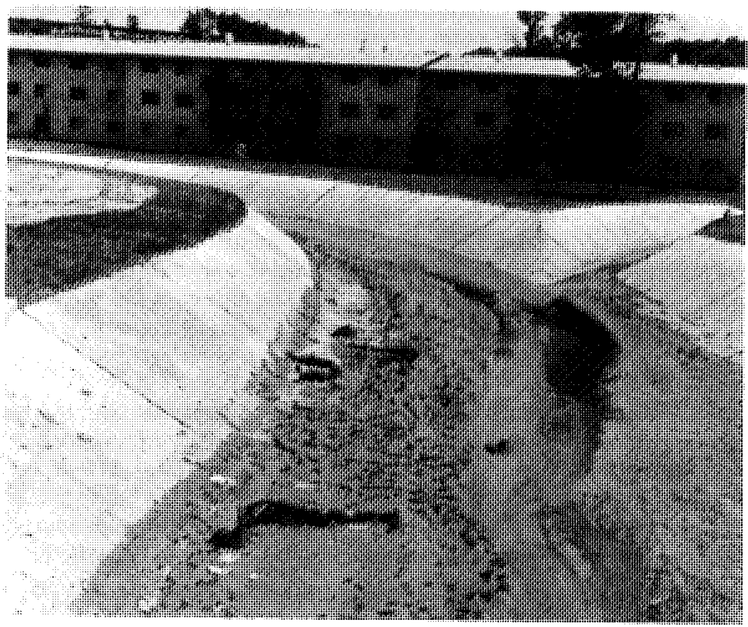
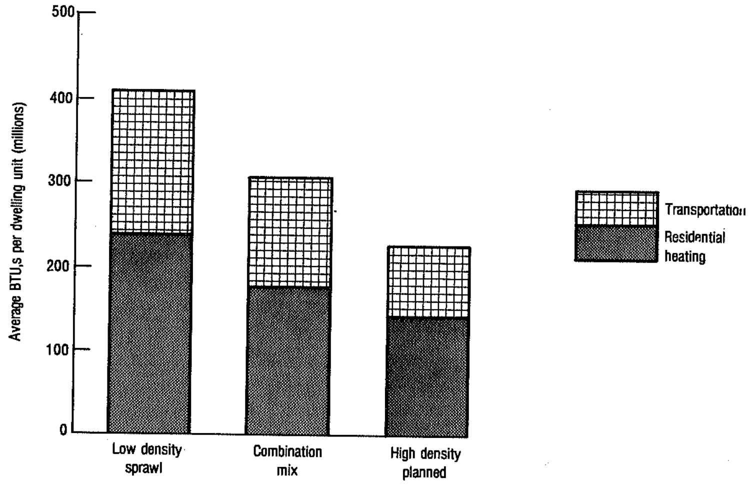


Figure 8

Community Cost Analysis
Annual Energy Consumption



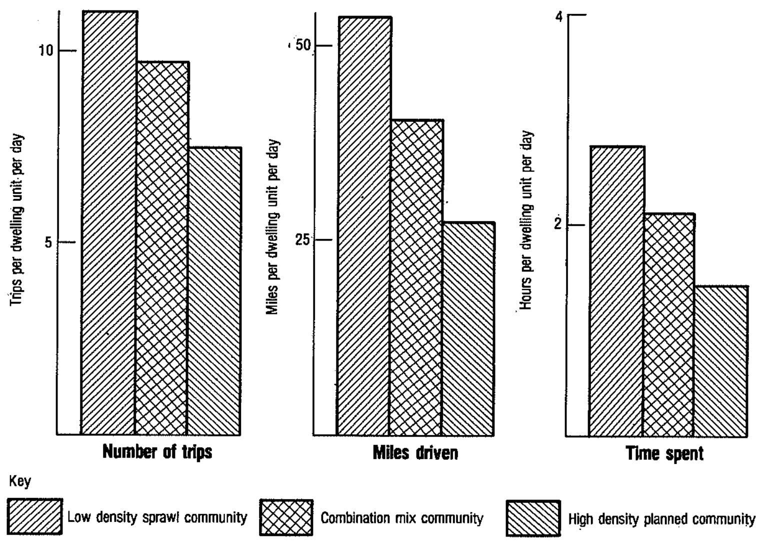
Source: *The Costs of Sprawl: Executive Summary,* p.5.

The community development pattern can also have significant impacts on energy consumption through affecting how much automobiles are used. Results from *The Costs of Sprawl* and other studies indicate that better planning, clustering, and higher density can all significantly reduce reliance on auto travel in terms of number of trips taken, number of miles driven, and amount of time spent in a car, as indicated in Figure 9.[19] These relationships hold true even when the amount of energy consumed in commuting to work is excluded, since commuting may not be directly affected by the development pattern of the residential community. The resulting energy savings are indicated in Figure 8. Increased density also reduces the amount of transportation required for the delivery of urban goods and services, as indicated in Figure 10.

There are additional, and perhaps even more important, savings in auto use (and therefore energy consumption) related to the pattern of urbanization at the metropolitan area level. Certain metropolitan configurations may result in reduced commuting and shorter automobile trips for shopping, recreational activities, etc.[20] and increase the viability of public transit. Even on the neighborhood level, transit can more efficiently service better-planned, clustered developments than those that are diffuse and random. For the same reason, the clustering of employment becomes important. Present urban growth patterns work against the use of public transit because both

Figure 9

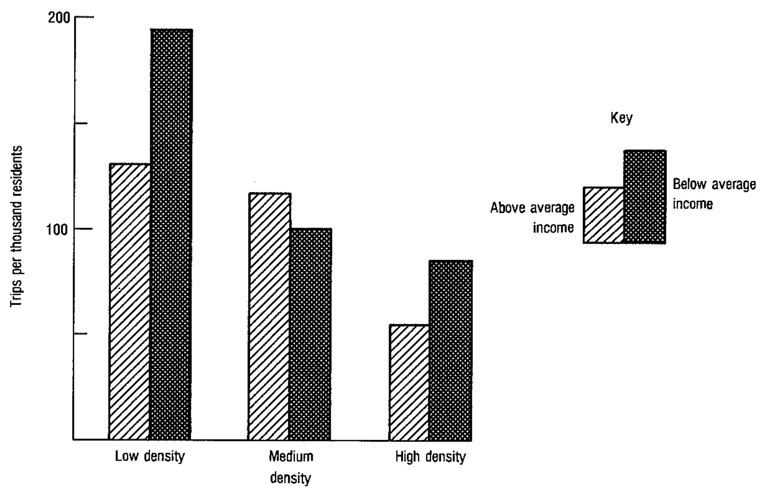
Automobile Use Related to Community Development Pattern



Source: *The Costs of Sprawl: Detailed Cost Analysis,* pp. 150.151.

Figure 10

Use of Trucks Related to Residential Density



Source: Wilbur Smith and Associates, *Motor Trucks and the Metropolis* (1969), based on data from three U.S. cities.

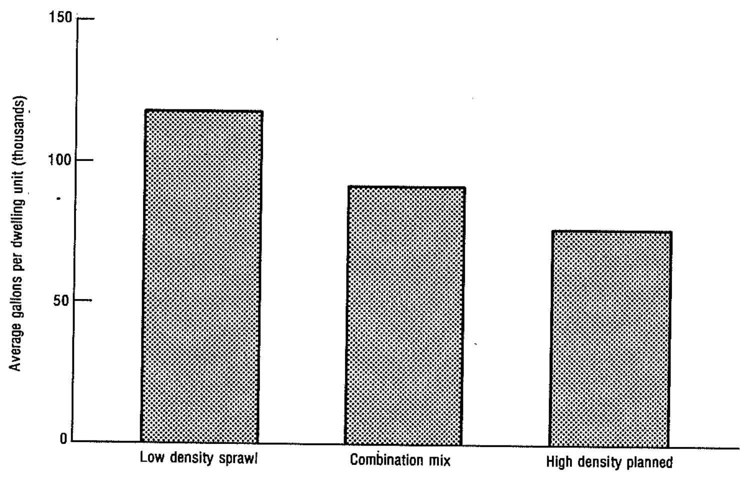
residential areas and employment centers are dispersed throughout the suburbs and on the urban fringe, where they are not easily served.

Water Use—Water is another valuable natural resource whose use may be significantly affected by urbanization. In some parts of the country, excessive urbanization in water-short areas (e.g., Southern California) has required substantial importation of water supplies. The amount of water consumed in cooking, drinking, and the like is not affected by either planning or density. However, water for lawns is affected by both.[21] For this reason, clustering alone can save 6 percent of total water consumption and, as indicated in Figure 11, overall high density planned development requires only 65 percent as much water as the low density sprawl development.

Social Costs—Many personal and social considerations are associated with patterns of urbanization, quite aside from the economic and environmental costs already discussed. These social effects are difficult to estimate. They are also strongly affected by the particular quality of planning and dwelling unit design. As noted earlier, good planning and clustering can reduce travel times by conveniently locating commercial and public facilities in relation to residential areas. Apartments and other high density housing require less time

Figure 11

Community Cost Analysis
Annual Water Consumption



Source: *The Costs of Sprawl: Executive Summary*, p.6.

for home maintenance than single family homes.[22] Good planning can also reduce the number of traffic accidents.[23]

The relationship of other social effects to housing types or development patterns is less clear. Denser developments, particularly those with a high proportion of rental units, seem to be characterized by less friendliness among neighbors than less dense forms.[24] People also seem to prefer to own their own land and to have private space surrounding their home. Furthermore, there is some indication that denser developments have higher crime rates, although it is impossible to separate the effects of the physical housing on these statistics from the numerous socioeconomic factors affecting crime, and the question of design from the question of density.[25]

Opinion surveys have indicated that Americans prefer to live in a rural or semirural setting, but many also prefer to have ready access to the services and other amenities associated with urban areas.[26] Given the size of most urban areas, these preferences are clearly incompatible. However, the provision of compact neighborhoods and communities interspersed with readily accessible open space throughout the urban area may provide an acceptable compromise for many. Present tends in new housing indicate a growing willingness to live in such an environment.

Other social issues which must be addressed in analyzing the effects of urbanization include employment opportunities, racial distribution, low income housing, and cultural and educational programs. Many aspects of traditional urban growth patterns in the United States appear to be working against articulated goals in these areas. Would other patterns be more compatible with these goals? Are these issues best addressed on the regional or on the local level? If the latter, how can we insure that the broader goals of society will be satisfied by local decisions?

We need to learn a great deal more about the relationships between land use patterns and social goals. Is this because the pattern of land use reflects the general state of our society, or is it because the way we use our land helps determine that state? There is increasing concern that the latter may be true.

Balancing Costs—The foregoing analyses show that different types and patterns of urbanization can have significantly different impacts on economic costs, environmental costs, natural resource consumption, and personal costs. *The Costs of Sprawl* study indicates that on neighborhood and community levels, for a given number of dwelling units, many of these costs can be reduced by better planning and increased density.[27] However, it should be emphasized that these results should not be interpreted as recommending one type of development over another; too many costs and benefits have not been included, among them those associated with personal preferences and those related to the revenues generated by different development types.[28] Nor should the results be considered to be directly applicable

to any specific development, either existing or proposed. The features of a particular site, community, or region need to be addressed individually.

Much still remains to be learned about these costs. In the meantime, development proposals are being made and approved. The urbanization process is continuing. Implicitly tradeoffs are being made among the various types of costs which have been discussed in this section. While there is no general methodology available for rigorously assessing these complex tradeoffs—for making an integrated analysis of economic costs, environmental costs, social effects, energy conumption, and personal preferences—progress is being made through studies such as *The Costs of Sprawl.*

Leisure Homes and Recreational Development

As incomes and leisure time have increased over recent years, there has been a growing demand for recreational facilities in rural areas. Out of this demand have come the phenomena of leisure home and recreational lot developments—high density developments in rural settings. These phenomena create the same types of costs as the forms of urbanization described above. With recreational developments, in fact, the long-term costs of development to both property owners and the public may be greater than in most urban areas, and there may be more urgent need for effective controls.

Leisure home developments, of course, are not a new phenomenon. The Florida east coast, Cape Cod, Estes Park, and Lake Tahoe have been the sites of second home construction for many decades. Originally, these homes were owned almost exclusively by wealthier Americans, and houses were often expensive and built on large sites.

The more recent boom in second homes and recreational lots has involved a far broader stratum of society. Increased affluence has given more Americans the opportunity and desire to obtain such properties for themselves. This, combined with a widespread belief in the profitability of investment in land and reinforced by favorable income tax laws, has provided the ingredients for the recreational land and leisure home boom. The lots are smaller, the houses are more spare than traditional summer homes, and demand is many times greater than it was even a few years ago. Today approximately 3.4 million American families own second homes. Including owners of recreational lots, a total of 5 to 7 million American families are estimated to own recreational properties of some kind.[29]

Table 4 presents a number of characteristics of households owning leisure homes. It shows clearly that these homes are no longer the province of the very wealthy. They are owned by families somewhat wealthier and somewhat older than the average but still comprising essentially a cross section of society. (Corresponding infor-

Table 4

Selected Characteristics of U.S. Leisure Home Owners and Total U.S. Population

Characteristic	Percent of all households	Percent of leisure home owners	Leisure home owners as a percent of total households
Annual family income			
Less than $5,000	29.4	18.8	2.9
$5,000 to $9,999	30.9	24.5	3.6
$10,000 to $14,999	22.6	23.7	4.7
$15,000 to $24,999	13.2	20.9	7.2
$25,000 or more	3.9	12.1	14.1
Value of primary home			
Less than $15,000	41.3	31.3	3.4
$15,000 to $19,999	20.2	17.8	4.0
$20,000 to $24,999	14.7	13.5	4.1
$25,000 to $34,999	14.1	18.1	5.8
$35,000 to $49,999	6.5	10.7	7.4
$50,000 or more	3.2	8.6	12.2
Tenure of primary home			
Owned	59.3	73.1	5.6
Rented	35.4	22.7	2.9
Co-op or condominium	0.5	1.1	11.0
Other	4.8	3.1	2.9
Primary residence			
Inside SMSAs	69.1	68.0	4.4
Central city	34.1	31.0	4.1
Urban balance	24.7	26.2	4.8
Remainder	10.4	10.8	4.7
Outside SMSAs	30.9	32.0	4.7
Urban	75.1	75.2	4.5
Rural	24.9	24.8	4.5
Rural–nonfarm	20.0	20.3	4.6
Rural–farm	4.9	4.5	4.1
Places 10,000 to 50,000	20.4	21.9	4.8
Age of head of household			
Less than 25 years	7.1	4.0	2.5
25 to 34 years	21.0	10.0	2.1
35 to 44 years	21.2	18.5	3.9
45 to 54 years	20.1	25.9	5.8
55 to 64 years	17.5	22.7	5.9
65 years or older	13.1	18.9	6.5
Family size			
1 person	17.6	13.3	3.4
2 persons	29.6	35.0	5.3
3 persons	17.2	18.1	4.7
4 or 5 persons	25.2	24.8	4.4
6 or more persons	10.4	8.8	3.8

Source: Richard L. Ragatz Associates, *Recreational Properties: An Analysis of the Markets for Privately Owned Recreational Lots and Leisure Homes* (Springfield, Va.: National Technical Information Service, 1974).

mation about owners of recreational lots is not available, although there is evidence that they tend to be less affluent.)

The material on leisure homes and other recreational properties was obtained from a study on leisure homes undertaken by the American Society of Planning Officials for the Council on Environmental Quality in association with the Department of Housing and

Urban Development and the Appalachian Regional Commission.[30] The study indicates the importance of distinguishing between two separate aspects of the phenomenon: (1) the purchase of recreational lots, which are usually part of large subdivisions of plotted land where few of the lots may ever be developed; and (2) the ownership of leisure homes, which may be built by the owner in a subdivision or on a separate site, or built in large numbers by a developer.

Recreation lot sales often result from mail solicitation or telephone calls, and many buyers sign sales contracts without ever seeing the land. The Interstate Land Sales Act requires most lot sales in interstate commerce to be registered with the Office of Interstate Land Sales at the Department of Housing and Urban Development. Table 5, showing the regional breakdown of projects so registered, and Table 6, showing leisure homes by region, indicate a heavy concentration of lots in the South and in the West. Six states—Florida, Texas, California, New Mexico, Arizona, and Colorado—contain over 80 percent of the acreage in registered recreational lot sales projects.

These figures demonstrate that recreational land and leisure home developments have become very important in the United States. With them have come a host of problems. Some problems are consumer-related, such as fraudulent advertising and high pressure sales tactics used to take advantage of naivė buyers. Attempts are being made to curb these unethical practices through implementation of

Table 5

Recreational Properties Registered with the Office of Interstate Land Sales

	Acres in projects		Lots in projects	
	Total	Per 100 acres of region's area	Total	Per 100 families in region
United States	**7,146,229**	**0.5**	**3,375,821**	**5.3**
Northeast	**231,555**	**0.2**	**133,671**	**0.9**
New England	77,251	0.2	36,766	1.0
Middle Atlantic	154,304	0.2	96,905	0.8
North Central	**279,214**	**0.1**	**224,886**	**1.3**
East North Central	168,634	0.1	132,389	1.1
West North Central	110,580	0.04	92,497	1.8
South	**3,370,140**	**1.0**	**2,037,908**	**10.6**
South Atlantic	2,243,119	1.4	1,113,146	11.8
East South Central	127,291	0.1	123,022	3.2
West South Central	999,730	0.4	801,740	13.5
West	**3,265,320**	**0.8**	**979,356**	**8.8**
Mountain	2,489,408	0.9	750,270	29.8
Pacific	775,912	0.6	229,086	2.6

Source: Richard L. Ragatz Associates, *supra* Table 4, pp. 84, 87, 500.

Table 6

U.S. Leisure Homes by Region, 1970

Region	Total housing units	Leisure homes [1]	Percent of all housing units in region	Percent of all leisure homes in United States
United States	**68,418,094**	**2,143,434**	**3.1**	**100.0**
Northeast	**16,641,954**	**556,790**	**3.4**	**26.0**
New England	4,031,531	221,806	5.5	10.4
Middle Atlantic	12,610,423	334,984	2.7	15.6
North Central	**19,018,773**	**667,148**	**3.5**	**31.1**
East North Central	13,323,755	421,225	3.2	19.7
West North Central	5,695,018	245,923	4.3	11.5
South	**20,730,508**	**631,242**	**3.0**	**29.5**
South Atlantic	9,970,059	287,374	2.9	13.4
East South Central	4,184,006	127,039	3.0	5.9
West South Central	6,576,443	216,829	3.3	10.1
West	**12,026,859**	**288,254**	**2.4**	**13.5**
Mountain	2,762,783	115,901	4.2	5.4
Pacific	9,264,076	172,353	1.9	8.0

[1] "Leisure Homes" are enumerated by combining the Bureau of the Census categories "Rural Seasonal Vacant" and "Other Rural Vacant." This combination basically includes housing units which are intended for occupancy during only certain seasons of the year.

Source: Richard L. Ragatz Associates, *supra* Table 4, p. 91.

the Interstate Land Sales Act at the Federal level and through similar laws in some states.

Other problems arise because such development brings what amounts to instant urbanization to rural communities—communities where local governments have little experience with the impacts of large-scale development and few land use controls or regulatory bodies to deal with them.

Many leisure homes are being built in subdivisions that differ little in appearance from typical middle income suburban developments. Yet they are often built to much lower standards. If the home remains a summer weekend retreat, this may not create serious problems. But experience shows that seasonal homes are often converted into year-round homes and leisure home developments into permanent communities. This process may take a few years or decades, depending on the proximity of the homes to urban employment areas. In the mountains of northern Virginia, some homes in recreational subdivisions are being occupied as first homes from the time they are built, with their occupants commuting two hours or more to jobs on the fringes of Washington and Baltimore.[31] School buses can be seen serving these developments soon after the first houses go up. In short, the leisure home subdivision of today is likely to become the permanent settlement or suburb of tomorrow and should be viewed as an early form of urbanization.

This being true, it is necessary for a community to consider very carefully what development standards are appropriate for these subdivisions, particularly in communities with little growth experience, where officials are not equipped to cope with rapid growth and change. Many rural communities initially welcome second home developments in the expectation that they will provide property tax revenue and income for the local economy. They usually do, but they also create costs. Local governments often end up bearing the cost of increased demands the developments place on such public services as fire and police protection, road maintenance, water supply, solid waste disposal, and sewers. As long as recreational subdivisions remain seasonally occupied, these costs are likely to be lower than the property tax revenues generated by the development. However, as soon as residences become permanent, costs to the host communities will rise rapidly as schools, medical facilities, and other public services are required.

The eventual public costs will be particularly high if the development was originally built to low standards. Septic fields may have to be replaced by a sewer system; poorly constructed roads may have to be rebuilt. Replacing such facilities is very expensive, often more expensive than building adequate facilities at the time of the initial development.

Not only will the costs of low quality development be higher to the government, but they will also be higher to the homeowners. Inadequate insulation, poor drainage, and insufficient heating capacity may be small problems during summer weekends, but they become major concerns at other times of the year.

The developments may also create serious environmental problems, although many of these can be avoided by careful design and review. Inadequate septic systems can pollute streams or aquifers and thus cause public health problems. Serious erosion can clog streams with silt. Demand for water can overtax local supplies. These environmental problems can cause particular difficulty because the most desirable sites for recreational developments are often in fragile environments unsuitable for housing development, such as steep mountain slopes, coastal dunes, or marshes.

In addition to such environmental problems, the developments also present potential conflicts with public recreation goals. The crowding of seasonal homes along the coast or around the shore of a lake often denies access to those resources for public recreation. And developing land adjacent to national parks and forests guarantees the owners that they will always have ready access to natural areas, but it prohibits the later expansion of public land holdings for the benefit of the general public.

Many of these problems are very similar to those faced in urban areas. The CEQ's study of second homes, mentioned above, will

attempt to help rural communities in dealing with proposed developments. One specific product of the study is an impact evaluation handbook for local officials to use in assessing the costs and benefits of proposed recreation developments.

How, Where, and When?

The discussion of the urbanization process at work in the United States indicates that we are just beginning to understand the significant environmental, economic, natural resource, and social implications of development patterns in our cities and outlying areas. While we are nowhere near developing a truly accurate methodology to foretell these implications in a given case, we have learned that some long-held beliefs about the development process need to be seriously questioned.

In part this is due to changing times and new information available about our society. It is striking to realize, for example, that more multifamily housing units than single family housing units have been built in our suburbs since 1971. And with the recent boom in recreational lots and seasonal homes has come the participation of a much broader spectrum of society than could have been anticipated, so that today such landowners are a virtual cross section of our whole society. Both of these trends are very important to the way our land will be used in coming years.

In part, the need to question earlier assumptions rests on a growing realization that some of these assumptions were wrong, or, at best, serious oversimplifications. It can no longer be assumed that single family homes are the cheapest and most efficient development pattern for localities on the urban fringe. The savings in public costs from higher density development, and the payoff from planning programs which set aside open space and provide public facilities as part of a rational plan established for the benefit of the whole community, are becoming clearer and clearer. Nor can the savings in energy consumption and the ability to reduce pollution levels through improving the pattern of urbanization be overlooked. These issues are equally important in areas impacted by second homes and recreational lot sales. The long-term economic and environmental impacts on the community are becoming increasingly difficult to brush aside in the rush to invite developers with their promise of new tax revenues and economic growth.

None of this should lead us to conclude that growth is wrong or that land development should not occur. On the contrary, the market will demand new housing and new recreation opportunities for a population that, even at current low birth rates, will continue to expand (for at least the next few decades) and become more affluent. The issue is not growth or no growth. Rather, it is how and where and under what conditions growth should occur. The sections which

follow deal with this issue, first by identifying major stimulants to development and then by discussing growth control mechanisms available to communities.

Development Stimulants

What causes development to occur in a particular location, in a particular pattern, and at a particular time? In the past these would have been considered academic questions. The answers would be interesting, perhaps, but of little importance to public policy. We accepted development as something that occurred naturally. The major concerns of government agencies were to see that development was well nourished with infrastructure and that it did not upset the fiscal viability of the community. This is no longer the case. As we become more concerned about where, how, and when, we become increasingly interested in the question of why.

There are, of course, a very large number of factors that interact to influence development decisions. Many of these factors—for instance, the state of the economy and the rate of population growth—cannot be significantly influenced by governments at the local level where most control over land use is exerted. But we are beginning to realize that it is possible to identify major stimulants to growth which can be controlled, and we are beginning to learn how to predict some consequences of these stimulants before they occur. While much work remains to be done in improving these predictive techniques, there is increasing interest in taking a hard look at the way such major decisions stimulate surrounding development of all kinds.

For example, the development of Cape Canaveral stimulated tremendous growth over a short period of time in Brevard County, Florida during the 1960's.[32] Likewise, the location of the Atomic Energy Commission and the National Bureau of Standards along an interstate highway north of Washington, D.C. has stimulated development along a 60-mile corridor leading to Frederick, Maryland. Defense expenditures have strongly affected the growth of cities such as Seattle as well as smaller communities surrounding military bases.[33] National parks have stimulated intense commercial development along their access highways.[34]

Even within already developed areas, government actions can affect the pattern of development. Some impacts of urban renewal projects on the viability of communities have been analyzed widely.[35] On a smaller scale, the location of the Kennedy Library near Harvard Square in Cambridge, Massachusetts, raises similar issues. The library facilities are expected to attract thousands of visitors a day to an already highly congested area. Traffic control and parking are big issues, but equally important to residents are the changes in land use

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that will occur in the Harvard Square area as older shops and stores give way to fast-food chains and souvenir stands.

The importance of such actions, at least in the present discussion, lies not in their direct effects upon society and the environment but in the way they influence decisions in the private sector. Because it will attract many visitors, the Kennedy Library will increase the relative profitability of tourist and quick-food shops, forcing out stores that serve the local populace. By reducing transportation costs, a new highway may induce private industries to locate in the suburbs rather than the central city. Locating government offices and private industries on the urban fringe increases the profitability of converting the nearby land into housing developments. In most cases, the private sector undertakes the development which follows, and it is the private sector which decides where, how, and when this development will occur. But the original governmental action, by significantly affecting the relative profitability of alternatives, has a primary role in stimulating these private sector decisions.

It is impossible, of course, to analyze here all stimulants to development, for such a discussion would have to cover most activities in both the private and public sectors. This section is limited to governmental actions because they are the actions that can be most directly controlled by the public. There is particular emphasis on actions by the Federal Government. After beginning with a brief analysis of Federal tax laws, the section analyzes another relatively new set of Federal regulations—those directed at reducing air and water pollution. This is followed by a discussion of the effects of different infrastructure investments—sewers, highways, and mass transit. Finally there is an analysis of the potential impacts of new energy facilities—stimulants of great importance in coming decades.

Federal Taxes

Federal taxes are widely recognized as having substantial impacts upon development decisions and land use, primarily because they treat some types of development more favorably than others.[36] Most widely known is the alleged preference in the income tax provisions for homeowners over renters. By allowing the homeowner to deduct interest payments and property taxes from his income, the Federal tax code may inadvertently provide an incentive favoring the construction of expensive, low density, detached single family homes.[37] The incentive is stronger for more expensive housing because high income families obtain more tax relief from deductions than low income families. It favors single family homes because they are generally preferred by homeowners, being viewed as more private and easier to protect and maintain than higher density forms of housing. The owner of rental property, in contrast, usually prefers multifamily structures because they are easier to supervise and main-

tain. Of course, the owner of rental property can deduct expenses and depreciation, and these tax advantages may be passed on in the form of lower rents.[38] Nevertheless, to the extent that homeownership has been encouraged, low density housing patterns have been encouraged. More recently, there has been a rapid trend toward obtaining many of these same tax breaks for higher density housing by creating owner-occupied dwelling units through cooperatives or condominiums. Condominiums now account for over one-third of all housing units under construction in many urban areas.[39]

Tax provisions on depreciation affect different types of property differently, because there are different depreciation rates for different types of investment. For investments in residential structures, the depreciation schedules favor investment in new construction over rehabilitation of older housing by allowing the former to be depreciated more rapidly.[40] The rules also encourage a rapid turnover of ownership of buildings because the major advantage of depreciation for tax purposes occurs during the early years of ownership, and accelerated depreciation (although at a lower rate than with a new building) begins anew with each subsequent owner.[41] Since the profit in a building can result from the depreciation deductions as much as from the income it generates, there is a disincentive to maintain the building in expectation of long-run income-producing potential.[42] The incentive is to build, depreciate, sell, and then build again. This creates an inducement to continue constructing new buildings where land is cheap—the land cannot be depreciated—while allowing older buildings to decay.

The Environmental Protection Tax Act, included in President Nixon's environmental legislative program for the past 2 years, would partially remove the discrimination in depreciation rates by providing the same rates for older buildings that have undergone substantial rehabilitation as for new buildings.[43] Even more favorable treatment would be given to older buildings registered as historically or architecturally valuable.

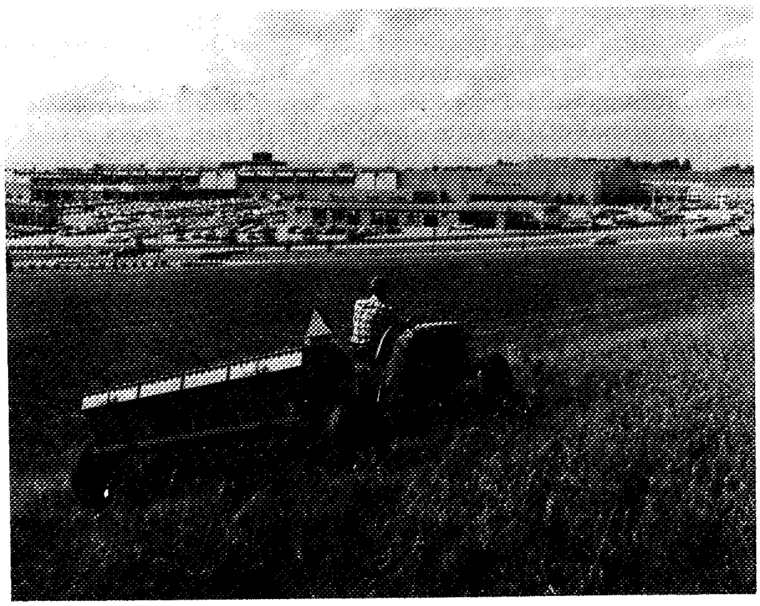
The fact that profits from buying and selling land are treated as capital gains and taxed at a lower rate than other types of income serves as a stimulus for land speculation. Some observers identify this capital gains treatment as perhaps the most important Federal tax provision in stimulating the conversion of open rural land to development.[44]

Tax provisions can also take some of the responsibility for the boom in the construction of leisure homes.[45] Although the regulations have been significantly tightened in recent years to remove many of the earlier incentives, it was formerly true that the owner of a leisure home, by renting the house out while he was not using it, could claim it as an income-producing property and therefore deduct, for tax purposes, many of the costs of owning the house (including accelerated depreciation) even beyond any rental income he re-

ceived.[46] These provisions reduced the real cost of owning second homes and thereby stimulated their construction.

Among other Federal tax provisions affecting land use is a provision that eliminates capital gains taxes on any appreciation in the value of the property occurring before an owner's death when that property is transferred to his heirs.[47] This provision establishes a strong incentive for families owning farmland that has increased substantially in value (usually at the urban fringe) to hold onto the land until the original owner dies. If the heirs then sell the land, they avoid capital gains taxes on its substantially increased value, a savings which would have been impossible for the original owner. This creates an incentive to keep land undeveloped longer than might otherwise be desirable to accommodate and direct urbanization best; it may be one major factor promoting leapfrog development patterns.[48]

Another Federal estate tax provision which may affect land use patterns requires farmland, woodland, and open space to be valued at full market value in determining the value of an estate.[49] Especially in the case of a farmer, whose main assets may consist of the land, the relatively high value placed on the farm property may force his heirs to sell it off to pay the estate taxes, even though they may want to keep the land in agricultural production.[50]



Some Federal tax policies encourage the retention of farmland, while others encourage its sale to developers. The result interferes with the normal incentives at work in the land market in urban areas and may be one cause of leapfrog development patterns.

This brief review of some provisions of the Federal tax code indicates that it may be a powerful force in determining the pattern of metropolitan and rural development.[51] It is reasonably safe to assume that most of these provisions have had development impacts that were not anticipated at their enactment. They were adopted for other reasons, such as stimulating the construction of residential units, or stimulating investment in general—valid goals which the provisions help to attain. However, some of the unintended side effects may not be desirable. It is important to identify these side effects and to determine whether they can be eliminated or mitigated without damaging the effectiveness of the provisions in accomplishing other intended purposes.

Pollution Regulations

A number of environmental protection laws enacted in recent years provide another important example of Federal legislation and regulations which, adopted to attain desirable goals, may have significant inadvertent effects on land use. This analysis focuses on the two most important of these laws—the Clean Air Act Amendments of 1970[52] and the Federal Water Pollution Control Act Amendments of 1972.[53]

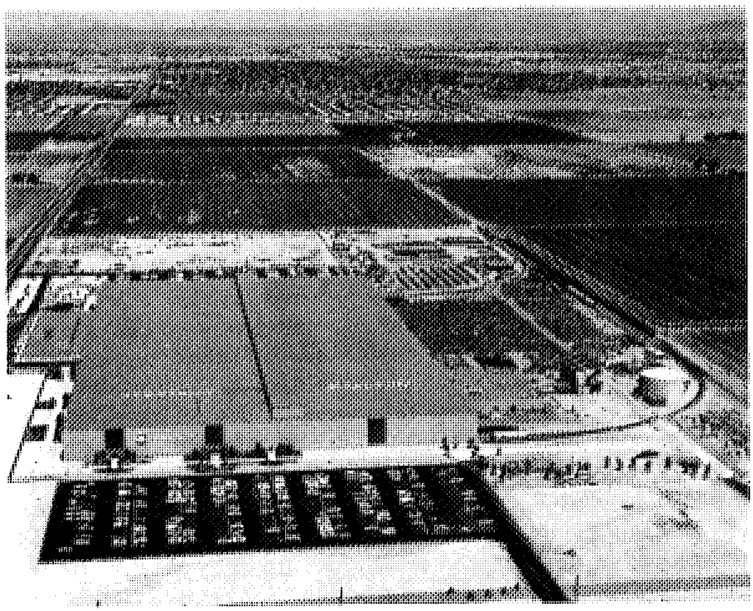
It is too early to assess with high accuracy what the land use impacts of various regulations under these laws may be or the extent to which they are controllable. Few impacts have yet appeared, and in some instances the final regulations have not been issued. Nevertheless, it is instructive to look at the incentives established in the legislation with respect to land use and to analyze the likely direction, if not the magnitude, of the resulting developments.

Air Pollution Regulations—Several facets of the Clean Air Act of 1970 are likely to have significant land use impacts.[54] Although some may be minor in terms of their land use effects, others appear to be potentially very important. The major legislative provisions are those which establish ambient air quality standards. Important regulations include: (1) those formulating transportation control plans for selected metropolitan areas to meet ambient standards;[55] (2) those providing for the approval of "indirect sources," facilities which, although not pollution sources themselves, attract large amounts of traffic;[56] (3) those attempting to define the meaning of "significant deterioration" of air quality in areas which presently have relatively pure air;[57] (4) those defining new source performance standards, which determine the amount of pollution that new facilities such as factories or power plants can emit;[58] and (5) those establishing the process and requirements for air quality maintenance through 10-year air quality maintenance plans in metropolitan areas.[59] Each of

these regulatory powers needs to be examined with respect to the way in which it affects development.

The ambient air quality standards, operating alone, would tend to induce polluting industries to locate in areas with relatively clean air, in order to reduce the costs of pollution abatement. This incentive to locate away from existing industrial areas, however, is at least partially offset by both the "new source" performance standards and the non-degradation regulations. The first requires all new plants, regardless of location, to employ a very high level of pollution control. This means that, in most cases, the cost of pollution abatement will not be affected by the location of a new facility. Although there is still some uncertainty about their final form, the non-degradation regulations may require more stringent abatement measures in relatively unpolluted regions than in regions presently attempting to meet primary and secondary air quality standards.

Although state and local planning agencies are expected to have the major role in defining what entails "significant deterioration" in any location, the regulations could interfere with what otherwise might have been a normal and often desirable relocation of manufacturing activity into new communities or small towns in rural areas. This may become a serious problem in the development of new western energy sources. Growing energy needs have made more



By influencing the location of new industries, many air and water pollution regulations will have significant land use impacts related to the industry itself and to related commercial and residential development pressures it causes in surrounding areas.

attractive the large deposits of coal and oil shale which lie in Montana, Colorado, and other western states. Those areas have relatively high quality air which will almost certainly be degraded if the energy development takes place.[60]

Of the other air quality regulations likely to affect land use within metropolitan areas, transportation control plans have received the greatest attention. These plans are aimed at reducing the amount of automobile traffic in order to meet ambient air quality standards. They involve, most commonly, implementation of some combination of the following strategies: (1) improved transportation control; (2) diversion of through traffic around central cities; (3) improved mass transit facilities; (4) special bus and car pool lanes; (5) elimination of on-street parking in the central business district; and (6) at local option, a parking tax on off-street parking in the central business district.[61]

The first two measures are aimed at reducing congestion and improving traffic flow to the central business district. Although, on a short-term basis, this should reduce the amount of air pollution generated by automobiles commuting to downtown, over the longer run improved access to the central city might well encourage people to live farther from their jobs and commute longer distances in their cars. This in turn could actually increase the generation of air pollutants.

The third and fourth measures are directed toward attracting more travelers to use public transit. They will tend to encourage increased development in areas served by mass transit facilities and to discourage sprawl development at the urban fringe.

The fifth and sixth measures are designed to make automobile commuting relatively more expensive and thus encourage more commuters to ride public transit. If these regulations are not vigorously enforced throughout the metropolitan area, they might also have the effect of encouraging the dispersal of employment centers out of the central city. Such dispersal could in turn affect the economic viability of the central city, as well as make it more difficult for lower-income central city residents to get to their jobs. It would also adversely affect the viability of the public transit systems that are supposed to be encouraged by other measures and would tend to encourage more development at the urban fringe. However, if the regulations are applied with the same force in the suburbs as in the central city, as EPA encourages, the effect could be just the opposite. Locations near the mass transit facilities would become more attractive, and development would tend to concentrate along public transit routes.

All of these transportation control measures, therefore, could have land use impacts. In some instances—for example if parking controls cause residential and industrial location patterns that discourage mass transit use—the incentives may work against each

other and result in land use patterns that actually increase the amount of air pollution generated.[62]

Another air quality provision relates to the control of indirect sources—facilities which, while they do not generate large amounts of pollution themselves, attract traffic which may create air pollution problems. They include major roads, shopping centers, stadiums, and other large public facilities.[63]

In most instances the indirect source review will focus on ways to mitigate traffic congestion and reduce air pollution levels (particularly for carbon monoxide). However, the review agency has authority to require the developer to undertake remedial action such as the provision of public transportation to his facility as a condition of the permit.

The indirect source regulations may have a significant impact on development decisions. They will tend to provide some incentive to the developer simply to avoid building the specific types and sizes of facilities covered by the regulations.[64] The resulting impact on land use is uncertain, but it could be perverse in terms of the goals of the act. For instance, prospective shopping center developers might turn to strip commercial development along highways as an alternative to uncertain project review procedures. Such a shift could avoid the permit process if it resulted in each store's parking lot being small enough. But this might mean more use of automobiles if shoppers drive from one store to another, simultaneously increasing congestion and air pollution.

Another set of regulations with possible direct impact on land use in metropolitan areas relates to air quality maintenance. These regulations require air quality agencies to prepare plans for metropolitan areas to ensure that the air quality, once it satisfies the ambient standards, is not degraded by future development. These plans may limit certain types of development in parts of the metropolitan area. In developing the guidelines for these plans, EPA is recognizing the importance of their being integrated with other planning efforts for environmental, economic and social goals.[65]

In sum, most of these air quality regulations appear to have the potential to affect land use patterns. In some cases it is not clear what the ultimate effect will be. Further analyses are obviously needed to ensure that the ensuing regulations as a whole will work together to meet the air quality purpose of the act, will affect land use in a desirable or at least neutral way and, further, will be consistent with the water pollution regulations described below. The recent decision by EPA to prepare and circulate environmental impact statements on major regulatory actions is a step in the right direction.[66]

Water Pollution Regulations—The 1972 Amendments to the Federal Water Pollution Control Act placed increased emphasis on the

control of the effluents from point sources. This shift in emphasis from ambient to effluent standards tended to remove the incentive to disperse new facilities which was similar to that associated with the ambient air standards described above.

However, there are at least three requirements of the amendments which will still affect industrial location decisions: [67] the effluent standards requiring the use of the best practicable or the best available technology; [68] the requirement that industries pay the full cost of treating wastes discharged to municipal plants; [69] and the requirement that industries pretreat their wastes before discharging them into municipal systems.[70]

Because it is generally less expensive to build pollution abatement technology into a new plant than to add it to an old one, and because abatement devices require space which may not be available at older congested industrial sites, the effluent standards may induce firms to abandon old plants, particularly those located in high density urban areas, sooner than they otherwise might have. Usually a new plant will be located outside the central city where more land is available at a lower price. However, new plants may be required to satisfy stricter standards than old plants, thus providing a countervailing incentive.

The combination of cost sharing and pretreatment requirements for industrial use of municipal treatment plants could also lead firms to conclude that they can more cheaply treat and dispose of their wastes themselves. If so, new industrial siting decisions would be influenced less by the availability of public sewers than they are currently, and this would be likely to result in wider dispersal of new industrial sites. If this stimulates industry to locate in small towns and new communities, it could be beneficial. If it leads industry to spread into undeveloped areas near cities, it could counteract desirable planning and regulatory efforts. Among other problems, the dispersal could promote inefficient development patterns from an air pollution and energy consumption point of view, development which would eventually come in conflict with the goals of the Clean Air Act.

Another regulation which may stimulate dispersed development is the requirement that every point source of pollution obtain a discharge permit. If water quality at a particular location presents a severe problem, as may occur in heavily built-up areas, the guidelines would suggest that permits not be issued unless the industry adopts very stringent pollution abatement techniques, perhaps even exceeding best available control technology. This again may tend to stimulate the dispersal of industrial and manufacturing activity. Again, it could be beneficial if it encourages industry to locate in smaller towns or new communities which need jobs, but detrimental if it simply contributes to metropolitan sprawl.

One opportunity to evaluate (and rectify if necessary) the location incentives created by these provisions is the requirement in

Sections 208 and 303(e) of the Act for wastewater management planning. These plans are intended to provide overall coordination of the many provisions of the Act as they apply to a given metropolitan area. They will also provide the mechanism for implementing Section 304(e) of the Act, which deals with the control of pollution from "nonpoint" sources. One major category of nonpoint pollution is stormwater runoff from land rendered impervious to water by streets, highways, parking lots, and commercial and residential development.[71] Regulating this form of nonpoint pollution could have significant impacts on development patterns.

In summary, it is clear that the Clean Air Act and the Federal Water Pollution Control Act have potentially significant land use impacts. It is not yet clear how serious these will be, or even what direction they may take. Much more analysis is required. But this brief review of the incentives established under the laws suggests that in some cases the impacts may not only conflict with other social and environmental goals but may also be perverse in terms of the attainment of the pollution control goals of the Act from which they derive.

EPA recognizes many of these problems and calls for integrated and comprehensive planning in its guidelines and policy statements.[72] However, analyzing all the potential land use effects, developing complementary guidelines, and overseeing the responsibility for preparing integrated plans which balance off the various environmental, economic, and social objectives is an extremely complex undertaking. In the meantime there is a danger that regulations issued before sufficient analysis can be completed will result in many of the problems outlined above.

Public Infrastructure Investments

While tax and regulatory policies may have significant effects on broad development patterns, the funding of new public facilities probably has the most direct and immediate impact on specific land areas. The influence of highways on land values and development decisions is understood best. Mass transit facilities also induce land use changes, particularly around stations. But new sewers are becoming in many metropolitan areas the prime determinants of where and how fast new development occurs.[73] Investments in water resource and water supply projects can also be powerful stimulants in the western United States.

Sewers—Sewers and sewage treatment plants are replacing highways as prime determinants of the location of development, in part because most of the major interstate highways segments located on the urban fringe have been built and additional highways have only

marginal effects on access. This replacement has also occurred because new concerns over water pollution have made it costly and sometimes impossible to build adequate septic tank systems and very difficult to receive approval to tie into existing overloaded sewage systems. And in part the replacement has taken place because new legislation makes billions of dollars in Federal aid available each year to communities to build new sewers and treatment facilities. Among other things, under the new program the Federal Government contributes 75 percent of the costs of these facilities, which substantially reduces the per unit cost of local sewer tie-ins.

The importance of sewers to the development process has been studied very little in the past. An examination of growth in the Far Northeast section of Philadelphia over the period 1945 to 1962 indicated that access to trunk sewers and high density zoning were the two most important factors influencing the price of residential land, and that the absence of sewers tended to restrict development.[74] Similarly, a more subjective analysis of the development process in Fairfax County, Virginia, concluded that the installation of interceptor sewers and the general pro-growth attitude of county officials were the prime determinants of the pattern of development in that area.[75] Another more quantitative study of the entire Washington, D.C., area also documents, though somewhat ambiguously, the importance of sewers in determining the location of the extensive development that has surrounded the city over the past decade.[76]

The location and rate of extension of interceptor sewer lines through previously undeveloped areas seem to have more impact on land use than any other set of decisions on wastewater facilities. Interceptor sewers are defined as the major lines that run from the collector sewers to the treatment plant. Because the location of a new interceptor significantly increases the number of buildable lots along its right of way, a key issue is its capacity. There is a general tendency for such lines to be oversized in order to assure the necessary capacity for future development, but the oversizing itself can contribute to the extent of development that occurs. Such oversizing thus becomes a self-fulfilling prophecy.

A related land use impact caused by large interceptor sewers is their tendency to be designed to run for long distances between existing towns before reaching the treatment plant. Such lines open up large areas of what may have been previously undeveloped land between the towns. While this may be in line with overall regional land use planning, it could also run counter to desirable development patterns, particularly if sewers are placed only with an eye toward wastewater treatment efficiency. In one recent case, a proposed interceptor was slated to run through a large undeveloped coastal area of Delaware that was on the state plan for eventual purchase as recreational land.[77] The proposal would have used public funds to build a sewer that would have substantially raised the purchase cost of the land to the public.

Major sewer lines have become the prime determinants of where and when new development occurs in many metropolitan areas. In addition to the land use impacts of new sewers, the developments they spur, if not properly controlled, can cause worsened problems of water pollution.

Another phenomenon related to the construction of large interceptors is the tendency for developers to move immediately to the end of the new line in order to take advantage of both the available sewer service and the low land costs on the far urban fringe.[78] The result is a costly leapfrog and fill-in development pattern, which increases the difficulty of properly planning the timing and size of other public facilities and spreads the urban area out in a pattern that is wasteful of land and energy resources.

Many of these problems could be avoided if the construction

of major interceptor sewers were phased to the extent feasible to coordinate with the extension of other public facilities in accord with a comprehensive land use plan. While annual or biennial extensions of such interceptors might make the sewer cost somewhat higher and the funding mechanism more complicated, it would probably result in overall cost savings to the community and would significantly reduce adverse land use impacts.

Similar issues arise when the analysis shifts from an individual interceptor to the design of an entire wastewater treatment system, including the treatment plant. Once again, cost factors favor the choice of large regional treatment plants with associated sewers. So far as water quality is concerned, these systems present economies of scale in construction and operation and require less monitoring and fewer highly trained personnel than a number of smaller treatment plants. But, as with sewers, the overdesign of capacity in the regional plant becomes a self-fulfilling prophecy. Coastal and other areas of seasonal home construction may be particularly affected because only a limited amount of land may be available for high density development, and because the potential buyer of a seasonal home or a recreational lot has greater freedom of locational choice than with his primary home. While a series of smaller but individually expandable plants might be more costly in such circumstances, the community could retain more control over development. Such a course would also give communities broader options to coordinate the expansion of wastewater treatment facilities with other public service programs. It is important to assure that such options are considered and the potential land use impacts are recognized prior to Federal funding.[79]

Highways—The major public investment program which has been analyzed most extensively in terms of growth-inducing effects is the Federal Highway Program.[80] Of course, the direct environmental impact of highway construction is also substantial. Each mile of interstate highway consumes up to 48 acres; over two-thirds of the land area in some of our cities is consumed by streets, roads, and parking; 26 million acres of America's rural land is consumed by transportation systems.[81] (See Table 2 above.) The earth moving required in the construction of such systems is a major source of soil erosion and increased sediment loads in rivers and streams. The paved area results in increased stormwater runoff, which can be heavily polluted with organic materials, oil, nutrients, and toxic substances. Air pollution, noise, community disruption, and the loss of parks, natural areas, and structures of architectural or historic significance are other direct effects of highway construction. But the effects on urban development patterns have been even greater.[82] Cheap energy, the automobile, and the highway have been major factors in determining the physical character of American metropolitan areas.

The impact of highways on development patterns, illustrated here by U.S. 89 in Arizona, has been rather extensively studied, but still too little is done to analyze such impacts prior to construction.

A number of studies, many of them conflicting, have been conducted on the impact of highways. In terms of interregional effects, the construction of highways seems to have had at most only a moderate impact on growth. For instance, an analysis of over 200 metropolitan areas which differed widely in the amount and type of highway construction indicated no significant effect of highway construction on population growth rates.[83]

Within a region, however, highways may have more important effects. A major highway linking a satellite city to a nearby major metropolitan area may induce a higher growth rate for the satellite city and for the corridor between it and the metropolitan area.[84]

Manufacturers consider highway transportation to be an important factor in their location decisions, once they have decided upon a region. Other factors such as availability of raw materials, the existence of markets, and supplies of adequately skilled labor have more influence in the choice of region, but highways become important in the site location decision within a given region.[85]

Commercial facilities, particularly those involved in wholesale and retail trade, show even greater sensitivity to the presence of highways in location decisions. Over the past two to three decades, wholesale trade has migrated steadily and significantly to suburban locations. Wholesale employment in the suburbs was negligible in the immediate postwar years; by 1963, it accounted for about 4 percent of suburban jobs.[86] Several studies have documented the significant impact of the interstate highway network, especially circumferential beltways, in this decentralization process.[87]

Retail trade may have an even stronger attraction to highways. Many of our modern regional shopping centers would not be financially feasible were it not for their ability to locate near the intersection of major highways.[88] In addition, certain categories of retail businesses—service stations, motels, restaurants, and drive-in establishments—are very strongly oriented toward highways.[89] The central business districts appear to have been hurt by improvements in the highway network of most metropolitan centers.[90]

Case studies show that highways introduce pressures for commercial development of nearby land.[91] Arterial streets and radial highways tend to promote strip commercial development, while circumferential highways tend to promote large-scale commercial, industrial, and residential developments.[92] Circumferential highways may also lead to accelerated commercial development along major arterials intersecting them.[93] Such interchanges provide the strongest stimulant for rapid land use changes, particularly into very high density development.[94]

Residential use of land is not related to highways in a simple way. Other factors (type of neighborhood, zoning protection, natural amenities, schools) have important influences, as do other types of public service infrastructure investments, such as sewers.[95]

The impact of highways on residential location depends to a great

extent upon the relative supply and demand for different types of housing, and the availability of accessible vacant land. Land especially close to the city and near an interchange will increase substantially in price and often can only be economically developed in an intensive way—either with businesses or high density housing.[96] Farther out at the urban fringe, where farmland is available for development, radial highways from the beltway promote conversion to low density single family subdivisions.[97]

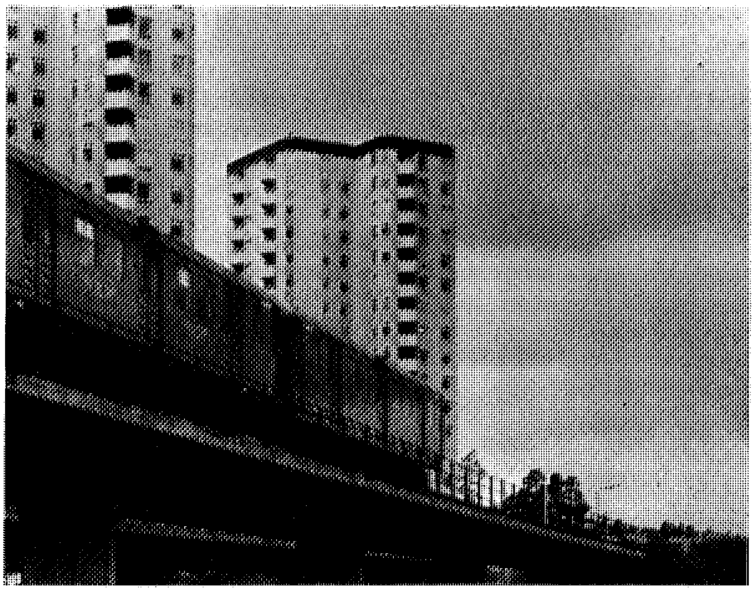
Efforts to distinguish among the impacts of different types of highways indicate that circumferential highways may result in more diffuse metropolitan areas than radial highways.[98] However, this conclusion is called into question by other studies, particularly those of the Washington, D.C., area.[99] Several studies indicate that circumferential highways stimulate more intensive development along their immediate corridor than would occur otherwise, and probably accelerate the amount of development between radial routes.[100]

Most observers agree that the large-scale highway construction during the 1950's and 1960's has had substantial impact on the development pattern of our metropolitan areas. However, most of the evidence indicates that the effect of new highways in metropolitan areas will be much less than the effect of those constructed earlier. The impact of a highway—particularly on residential development—is strongly influenced by the amount of vacant land it opens up for development relative to what is already accessible. The first interstate highways in metropolitan areas had substantial impact because they opened up relatively large amounts of land. Later highways may have less impact because they are built in areas that already have some access. But new roads on the urban fringe, especially beltways, may still be an exception to this rule.

In summary, under some conditions highways can affect how and where development occurs, and the possible impacts should be carefully considered in planning and reviewing proposed new projects. Control of these impacts through better planning and staging of the highway and its interchanges should be investigated.

Mass Transit—There is evidence that some of the new mass transit facilities being planned or constructed in U.S. cities may stimulate very important growth effects. This is not a new phenomenon. The early growth pattern of many metropolitan areas was established by the trolley lines radiating out from the central business district.[101] Residential development was concentrated in a narrow band along these lines, and its spread was determined by their expansion.

Unfortunately, very little information is available to predict the impacts of more recent mass transit systems. Few facilities have been constructed in recent years, and their impacts have been very difficult to separate from the many other factors influencing urban growth. There are only a few studies available which analyze the types of impacts to be expected, and these depend less on a rigorous analysis



The growth effects of mass transit facilities are primarily related to the development of high density residential and commercial facilities around stations.

of empirical data than on a qualitative description of what is expected or has been observed.

The characteristic of rapid transit facilities which distinguishes them from new highways is the degree of high density residential and office building development they stimulate around stations. Rapid transit facilities are used for moving people but seldom for moving goods. Therefore, they have more effect on activities that are people-oriented—residences, office buildings, cultural and recreational facilities—than on those that require the transportation of goods.

The construction of rapid transit facilities into the downtown area can have a significant impact on building activity and land prices in the central business district and along the transit corridors leading into it, as has been demonstrated in Toronto and San Francisco. An analysis of real estate changes in Toronto indicates that two new subways, constructed in 1954 and 1963, increased property values along their routes substantially.[102] About half of all highrise development and the bulk of office building construction occurred in areas within a 5-minute walk of the stations.

Such comparisons should not be taken as proof that the subway (or any other investment) is responsible for increasing the total assessed valuation of the city. It is just as likely that the subway did nothing more than concentrate along its path the increase in values that would have occurred throughout the city in any case.

The BART line in San Francisco appears also to be stimulating

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a rapid increase in the number of highrise office buildings and apartment houses being built along its route. While recognizing the overall benefits to the vitality of the city, many San Franciscans are concerned about the changes in the aesthetic, social, and cultural character of their downtown resulting, at least in part, from the subway.[103]

Such effects also occur elsewhere than in the central city. Studies of the Philadelphia-Lindenwold High Speed Line (which currently connects Philadelphia with the suburbs and a satellite city across the Delaware in New Jersey) indicate that since its opening in 1969 the facility may have accelerated the movement of enterprises out of Philadelphia into other communities along its route.[104] Similarly, there is some indication that San Francisco's BART is stimulating the construction of office buildings along its route in otherwise suburban communities.

Energy Development

Whereas the provision of public services determines where development is likely to take place within a particular area, there are some decisions that may have an impact on regional growth. This is exemplified by proposed energy-related developments—deepwater ports for supertankers, outer continental shelf (OCS) oil and gas production, extensive strip mining of western coal, the Alaska pipeline, and the production of crude petroleum from oil shale. In addition to affecting air and water quality, water supplies, marine resources, wildlife, and land resources, these facilities are expected to generate substantial industrial, commercial, and residential development. This development will often occur in rural areas where relatively little growth could be expected in the absence of the energy facilities.

The mining and shale oil developments in the West and the Alaskan pipeline are likely to have severe impacts on small towns. They will bring with them large numbers of workers, first for the construction of the facility, then for its operation, and finally for the construction and operation of associated industries. The population growth will often place great stress on the ability of the community to finance and provide the required services. Some public and private groups are studying these problems and are attempting to prepare in advance for the developments in order to avoid impacting local communities so that they take years to recover.[105]

The Council, in association with other Federal agencies, has completed detailed studies of the secondary development expected from two types of energy developments—deepwater ports [106] and OCS oil production on the East Coast and in the Gulf of Alaska.[107] Both studies, which are discussed in Chapter 6, project heavy onshore investment resulting from the offshore production or importation of crude oil. While this investment may bring a welcome economic boost

Energy facilities in rural areas generate nearby development to accommodate first construction workers and later employees and their families. This development can be either like the unplanned trailer park surrounding a new power plant in Wyoming (top), or like Boulder City, Nevada (bottom) which was started in 1931 as headquarters for the Hoover Dam construction and is known today as "Clean Green Boulder City".

to many coastal areas which have grown little in recent years, it will also cause tremendous physical changes in the natural and man-made environment. The initial effect will be the construction of refineries to handle the crude oil, followed probably by petrochemical industry complexes which require oil and gas as raw materials. The industries will create a substantial demand for workers, first for their construction and then for their operation. The workers, in turn, will require housing, stores, schools, and other services, which will stimulate rapid development and strain the ability of local governments to provide the services required. The physical environment of the coastal area may be transformed as much or more by this development process as by the energy facilities themselves.

The scale of these changes can best be understood by looking at the potential impacts in a specific area. The counties of Cape May and Cumberland in southern New Jersey provide a good example. These counties are decidedly rural, containing only 2.5 percent of the state's population but 10 percent of its land.[108] Per capita income is less than half the state average.[109]

The CEQ superport study concluded that, even if oil imports are low and are refined mostly at existing facilities located elsewhere, a major expansion of petroleum-related industry in the Mid-Atlantic states by the end of this century will still have a strong impact on the two counties.[110] Under other assumptions concerning the level of imports, dramatic changes could occur much sooner.[111] From a purely economic standpoint, such development would benefit the two counties. By the year 2000, twice as many jobs as expected under normal conditions could be created and average per capita income might be more than 20 percent higher.[112]

On the other hand, the environmental impacts on the region would be alarming. The amount of developed land in the two counties would triple in less than 30 years. Crude oil storage, refining, and petrochemical operations alone would cover over half of Cumberland County's bay shore, permanently changing its character and causing major conflicts with recreation, wildlife, and wetland preservation. Some of these effects might be avoided by locating major industrial facilities farther inland or at existing industrial centers in the Delaware Valley.

In addition to these land use impacts, massive amounts of water would be needed for industrial cooling and processing and for the increased residential population and subsidiary commercial development.[113] The potential for air pollution would increase significantly as well.[114]

The Council also looked closely at these two counties in its study of the onshore impacts of outer continental shelf (OCS) oil development and found similar impacts. OCS development would increase the number of jobs by 20 to 30 percent over the base created by superport development, more than doubling the 1970 population.

Industry would replace tourism, fishing, and agriculture as the economic base, and large numbers of new public facilities, especially schools, hospitals, and waterworks, would have to be built. These facilities would have to be provided by small towns and especially the fishing villages along the shore of the Bay, localities which often lack the economic capability to support, and the land use planning and regulatory tools necessary to control, such a volume of growth.

For most public officials at the state and local levels these induced impacts appear to be the most important effects that can be expected from the development of new energy facilities. The various studies referred to here attempt to provide officials and the public with information and analytical tools to predict and adequately plan for such developments. There is a significant need for more of these analyses and for cooperation among Federal, state, regional, and local bodies in carrying out the required planning and its implementation.[115]

Stimulants as Controls

This section has dealt with only some of the more important Federal actions that can significantly affect where, how, and when development will occur. But not even all the relevant Federal programs have been covered. There has been no discussion of the Federal Housing Administration regulations and mortgage guarantees, for example, which, in addition to stimulating the construction of single family detached homes, have had a very important impact on the quality and form of much of our suburban development.[116] Nor have the effects of defense and space expenditures, which have contributed significantly to the development of certain regions of the country, been more than briefly mentioned. The role of water resource projects both as a determinant of land use on a local level and as a development catalyst for many areas in the western United States has been ignored. Finally, being focused predominantly on metropolitan areas,[117] the analysis has ignored the many programs, particularly those implemented by the Department of Agriculture, which determine the whole structure of American agriculture and greatly influence development around small cities and towns in rural America.

By concentrating on Federal actions, even in this limited way, this section has also omitted, except for some facilities jointly funded with the Federal Government, the many state and local actions which are development stimulants. The county or community's willingness to provide infrastructure—particularly water, roads, sewers, and schools—for new developments is a significant determinant of where, how, and when that development will occur.

There are many other examples of local stimulants. Sales taxes, particularly when local governments receive their proceeds, provide an

incentive for the promotion of commercial facilities.[118] Many local land use planning and regulatory efforts stimulate sprawl and increased automobile use. For example, a basic tenet of zoning has been to segregate land uses—to keep residences apart from industries and commercial areas. With such development patterns, people must travel farther to get from one type of area to another; hence, the need for more automobile travel. Parking requirements, normally included in commercial zoning ordinances, also encourage use of vehicles. Easy parking makes easy driving.

There is increasing recognition of all these effects, and of the fact that actions usually undertaken for specific limited purposes ultimately have wide-ranging economic, social, and environmental impacts. In some instances, because of their influence on land use, the effects of such actions may end up being more environmentally, economically, and socially undesirable than the problems that they were originally intended to correct.

For these reasons, such impacts cannot be ignored in analyzing the desirability of proposed actions. They should weigh heavily, for example, when an agency is considering alternative public works investments or the best means of implementing a legal requirement through regulations.

But predicting such effects is not easy. The significance of any stimulant may change over time, as witness the apparently decreasing importance of highway investments and the increasing importance of sewer investments in affecting urban fringe growth patterns. The significance will also vary from place to place. A highway may be an important stimulant in one area but not in another. Sewer investments may lead to increased sprawl in one community, but a lack of adequate sewer investment (by forcing increased use of septic tanks and hence low density development) may have the same effect in another. And finally, the importance of these effects will depend not only upon their physical dimensions but also upon the values of the particular community in which they occur, values which change greatly from place to place and from time to time.

Because of the importance of the stimulants and the way their effects vary from case to case, the Council believes strongly that their analysis (with respect to Federal actions) should be included as part of the environmental impact statement.[119] As a first step the Council is working with several Federal agencies to develop tools which will allow the better prediction of such "secondary effects."

At the same time, local planning officials are beginning to recognize how the stimulating effects of infrastructure investments can become a tool in controlling development. By carefully planning where the investments will be made and how they will be staged, local, regional and state officials can strongly influence where, how, and when. This use of stimulants as controls is discussed in the next section.

Land Use Controls

Every community has tools available to it to control and direct the development process. Some of these land use controls are well-established and well-known, although even the most traditional have undergone changes and refinements in recent years. Others are new and relatively untried, some offering promise, and others having some obvious pitfalls.

Quiet Revolution Revisited

In 1971, the Council on Environmental Quality documented the movement toward more effective land use controls in its report, *The Quiet Revolution in Land Use Control.*[120] This report analyzed innovative land use controls in a number of states, including Hawaii, Maine, Vermont, Massachusetts and Wisconsin. It also examined regional efforts such as those of the San Francisco Bay Conservation and Development Commission and the Twin Cities Metropolitan Council.

Since the publication of *The Quiet Revolution,* efforts to strengthen the role of the states and their regional governments in regulating the use of land have continued. Forty-eight states have now enacted legislation or are seriously studying proposals to expand the previously limited role of state government in the regulation of land use. (See the Appendix to this chapter.)[121] Initiatives undertaken by the states include review of major industrial location decisions such as power plants, assistance to localities to plan better for the siting of growth-inducing public facilities, controls on surface mining, and protection of important natural areas—particularly coastal zones, wetlands, floodplains, and mountain regions—and historical areas from undesirable development. In all cases, most land use decisions continue to be made by local governments. But the states are creating procedures in which the broader state perspective is applied to the development process.

Six states (California, Delaware, Maine, New Jersey, Rhode Island, and Washington) have enacted particularly broad state authority over land use decisions in defined coastal zones, where the conflicts among competing uses of limited land resources are often most severe. Six others (Connecticut, Georgia, Maryland, Massachusetts, North Carolina, and Virginia) have singled out wetlands for state protection; most now require permits for any draining, dredging, filling, or construction in such areas. Minnesota, Michigan, and Wisconsin have strong shoreland and floodplain protection laws. Utah has enacted critical areas legislation.

Three recently enacted state laws deserve particular mention. The 1972 Florida Environmental Land and Water Management Act[122] (Act 380) provides for state designation of "areas of critical state

concern," which are regulated by local government under state guidelines or directly by the state if the localities fail to live up to guideline requirements. The 1973 comprehensive act in Oregon (Senate Bill 100)[123] takes a similar approach to state and local roles in land use planning and regulation, with a state land use commission developing policies and goals to be implemented by local governments. The State of New York in 1973 amended its Adirondack Park Agency Act to provide state-level control over development on privately owned holdings comprising over one-half the acreage within the park area.[124]

At the same time, many communities have taken a more aggressive role in attempting to bring about better land use. There is increasing citizen pressure, particularly in suburban areas of major cities, to improve planning, to evaluate more fully the effects of development, and to strengthen local development controls.[125] An increasingly sophisticated public has come to realize the point made throughout this chapter—that major development significantly affects the local economy, the tax burden, and the environment. In a recent study for EPA, the International City Management Association found that 36 percent of all counties with populations of over 400,000 and nearly one-fourth of all cities with populations of over 10,000 have created citizen environmental commissions to confront these and other issues.[126] Further, the study found that approximately half of the cities and counties cited citizen support for environmental issues as being a major factor in the creation of environmental protection programs. As noted in last year's Annual Report, emphasis on growth and change is being replaced by a concern for stability, for protection of the environment and for a greater sense of community.[127]

A new appreciation of the importance of land use issues is also beginning to influence thinking at the Federal level. In the past the Federal role in land use was focused primarily on the management of that one-third of the Nation's land comprising Federal lands, forests, and parks.[128] Now, as indicated in the previous section, there is general recognition that many Federal policies and programs influence other land use and development decisions.

Recent laws define a new Federal role in dealing with land use issues. The Coastal Zone Management Act of 1972, administered by the National Oceanic and Atmospheric Administration, provides assistance to 34 coastal states and territories wishing to establish resource management plans in defined coastal areas.[129] In its first year of operation, the program was able to fund eligible programs in all but one of the designated states. The Flood Disaster Protection Act of 1973[130] empowers the Department of Housing and Urban Development to work with 15,000 flood-prone localities in the United States to upgrade regulation of development in floodplains as a condition for disaster relief and insurance for structures now existing on floodplains.

Controlling Development

It is rare to find a locality where only one type of land use control is in effect. More commonly, there are several controls, and it is their interaction—the way in which they complement or counteract one another—which effectively determines the degree and character of control exercised. It is useful to analyze the effectiveness and impacts of the individual control mechanisms.

Zoning—Zoning, the most common system of land use control, attempts to predesignate the purposes for which land can be used. In doing so, it serves to segregate uses into assigned geographic areas, keeping, for example, heavy industries apart from residences, or even single family housing apart from multifamily housing.[131]

Zoning can have significant impact on land values, though the direction and significance of the impact depends on how well zoning is administered and on supply and demand situations in the land market. The character of a residential neighborhood, for example, is a major determinant of the value of its houses. Zoning assists in the creation and preservation of these characteristics by excluding conflicting land uses, such as industry and large-scale commerce.[132] Zoning may also increase property values by restricting the amount of land available for particular uses. For example, if there is a large

Some land use controls require no compensation because they protect the public health and welfare; residential development, for example, should have been barred from this floodplain.

demand for multifamily housing but very little land zoned for that purpose, the small supply of land is likely to find a very high market price.[133]

Zoning can also reduce property values. Land that is permanently zoned for less profitable uses, such as agriculture or large-lot single family homes, will bring a lower price than land zoned for higher density uses. The degree to which land can be restricted to less profitable uses is an issue of constitutional law dealt with in *The Taking Issue,* a report issued by the Council last year and discussed in Chapter 4 of the Fourth Annual Report.[134]

Zoning has certain inherent problems as a land use control. Inasmuch as it can change the price of land from its free market value, zoning may create economic incentives which work against the successful implementation of the desired development patterns. For example, if two parcels of land, alike in every other respect, are zoned for different purposes—e.g., one for multifamily and the other for single family housing—and if the land prices differ because multifamily development is more profitable, then a potential developer of multifamily units has an incentive to buy the cheaper land and use his influence in the locality to get the zoning changed.[135] When this "spot zoning" occurs, it results in such land use aberrations as garden apartments surrounded by farms—not where proper land use planning would locate apartments nor even where they would be built were there a completely free market.

A second problem with zoning derives from its underlying assumption that different uses should be segregated. In terms of convenience, environmental effects, and energy consumption, there are often significant advantages to locating neighborhood facilities such as a grocery store or a pharmacy within a residential area. Traditional zoning, however, generally prohibits such an intermingling of uses. Recent trends in planning and zoning seek to remedy this deficiency by moving toward a more beneficial integration of different land uses at the proper scale.

An even more basic question in zoning is whether it is possible, or even desirable, for a community to establish firm criteria for land use that are expected to remain unchanged over a long period of time. Experience suggests that it is not. Commonly, zoning regulations are transformed. Amendments and variances which were originally intended as rarely used safety valves often become the rule. As a result, zoning provides neither stability of use nor a logical mechanism for definition of use. Some new techniques being used to overcome these problems are discussed later in this section.

Aside from various inherent problems, the manner in which communities actually implement their zoning ordinances is often criticized. It is said that many communities have intentionally or unintentionally adopted zoning regulations which effectively bar low or even middle income housing from the community,[136] pri-

marily through regulation of lot size, frontage, living space, and setback.

It is generally, though not unanimously, accepted that zoning plays a part in the determination of housing costs.[137] Because housing costs and lot size have a direct and positive relationship to municipal tax revenues, while public service costs per given household are relatively constant regardless of housing costs, municipalities have an incentive to engage in "fiscal" zoning—attempting to maximize the revenue provided by the land and improvements, while limiting the number of new families entering the community.[138]

Many communities have adopted large-lot zoning in the belief that it will preserve open space and slow development. Under these ordinances, a house may be built only if it is on a lot of several acres. But large-lot zoning may increase environmental problems and create undesirable economic and social consequences.[139] It is damaging to environmental quality in that it takes low density development farther and farther into the countryside. This requires more roads because of the greater distances and necessitates more travel by car, thereby increasing energy consumption and air pollution. As a result of the greater distances between houses, large-lot zoning forces communities to pay more per resident for sewer, electric, water, and other infrastructure systems, which in turn leads to increased property taxes and provides additional stimulus for "fiscal" zoning.

Fortunately, there are new zoning techniques available which deal more efficiently with some of the problems of traditional zoning. Two of the most important are the planned unit development (PUD) and the special purpose district.

The PUD technique is seeing increased use across the country, particularly in communities at the urban fringe. Usually embodied as part of the local zoning ordinance, it provides increased flexibility for the design and siting of residential development. Under the PUD technique, the builder is permitted to aggregate the total density permitted for his tract into clusters of higher density development. The specific plan is determined through negotiation between the developer and the planning board, working within broad legislative guidelines.[140] For the developer, this results in savings in building costs. For the community, it preserves relatively large unbroken areas of open space (usually 10–20 percent of the total) and reduces many of the costs caused by typical sprawl development.

The PUD technique can apply equally well to luxury developments or moderate priced housing. Some of the most desirable housing in many communities is located in the PUD's where savings in housing costs are applied to better community facilities. Or the cost savings can be used to provide a greater diversity in housing to serve better the individual needs and economic capabilities of potential residents.[141] Smaller units for elderly residents, for example, can be interspersed with larger residences.

The second innovative technique is the special purpose district. Like the PUD, the special district is typically a part of the local zoning ordinance, designed generally to give greater leeway in development and to break traditional zoning's inflexible focus on the single lot. Whereas the PUD is designed for new developments, the special purpose district generally is created to protect existing desirable uses in particular areas of social, cultural, or historical importance that are threatened by pressures for redevelopment. The special purpose district is subject to controls on design and use, and it provides various incentives and bonuses to complying developers.

The technique has been used most often in the preservation of historic districts, such as New York City's Greenwich Village. But it has found application as well in other areas of that city, where it has helped to revitalize the Broadway theatre district, to encourage the continued existence of luxury shops along Fifth Avenue, and to preserve low income housing.[142]

Special purpose districts and PUD's attempt to come to terms with the problems and potentials of a specific area. Both techniques grow from a recognition that normal zoning ordinances are often too clumsy to deal with the delicate process of preserving and enhancing environmental quality.

Review of Development Proposals—Traditional zoning ordinances attempt to control land use by determining before development occurs what every piece of land will be used for. As long as any proposed development satisfies the designated land uses, it is allowed. But to assure that it does, most communities have also adopted laws for the review of major development proposals. These laws vary from the simple requirement to file a map of platted acreage for a new subdivision to highly sophisticated techniques and reporting schemes with guidelines, regulations, and provisions for public review.[143] There is an increasing recognition that development proposals must be examined on an individual basis under a system of review that has both clearly defined standards and the flexibility to take into account changing community values and the special characteristics of each project.

A typical project review ordinance establishes very general guidelines for development and leaves certain choices concerning the design and location of the development to case-by-case negotiation between the developer and the municipal officials. The Ramapo, N.Y., law takes a somewhat different approach, establishing a point system based on the location of development with respect to existing infrastructure and on the developer's willingness to supply various public facilities himself.[144]

Environmental impact statements required by the National Environmental Policy Act and by laws enacted in numerous states and localities are another form of project review, requiring that governmental agencies review in a public document the impacts of projects

they propose to approve or undertake. In California, state legislation on impact statements has been interpreted as applying to significant private actions as well.[145] Increasing emphasis is being given in impact statements to both direct land use impacts and changes in surrounding land uses likely to be induced by the proposed action.

Other state laws have created procedures and special boards for reviewing development proposals. California's Coastal Zone Act set up a statewide commission and regional panels to analyze impacts before approving development proposals.[146] Vermont's Environmental Control Law (Act 250) requires a review by a regional environmental board for all subdivisions over 10 acres, any commercial or industrial development of substantial size, and any development above 2500 feet in elevation.[147] Comprehensive state review of power plant siting has been established in a number of states, including Arizona, Arkansas, California, Kentucky, Maryland, Massachusetts, Minnesota, Montana, New Hampshire, New York, Ohio, Oregon, Virginia, and Washington.[148] Texas and Louisiana require project review before construction of superports.[149] Delaware, in addition to banning heavy industry from its coastal zone, has established a permit system to review and approve other types of industry there. On the local level, the Association of Bay Area Governments in San Francisco has established "Project Review Criteria for Growth," which are applied in order to analyze the environmental and social impact of proposed development.[150]

Each of these approaches seeks to resolve a very important question in land use regulation: to what extent should controls be exercised through traditional zoning methods of predesignating permitted uses, and to what extent should each development proposal be given special review? Most procedures being adopted at present include a mixture of both. Traditional zoning is less likely to cause delays in development and may provide less opportunity for arbitrary or capricious actions by public bodies. On the other hand, it tends to be inflexible and unresponsive to public opinion, and it often interferes with solutions that best serve the longer-term interests of both the private developer and the public. The consequences of poor design and improper site location are long-term losses for the residents and the community. Hence, the current trend is clearly toward more case-by-case review as the only way to assure adequate sensitivity to community and environmental impacts. This move away from preregulation toward more thorough review of development proposals is also reflected in two other new development control techniques which are discussed below: development rights and land banking.

Development Rights: Donation, Purchase, and Transfer—The Constitution places limits on the taking of private property by public authorities without just compensation. Under a series of court cases in the early part of this century, the concept of "taking" was held to apply to government regulation of land.[151] This limits the severity

of land regulation which can be applied in the name of the general welfare without requiring that the owner be compensated for the taking. For the most part, the determination of what constitutes a compensable taking has been left to state courts,[152] and, as might be expected, the line between legal and illegal regulation varies among the states, as well as over time within the same state. Some state courts have held that restricting development to 1 house per 5-acre minimum lot size is a reasonable use of public power but draw the line at a 10-acre minimum lot.[153] To some extent, of course, the land itself dictates reasonable uses. Public authorities can be more restrictive with respect to floodplains because development there poses potential dangers to residents, and with respect to wetlands because of their value as natural breeding areas.

What is left to the landowner after the community has placed such legal restrictions on his ability to use his land is seen by the law as a bundle of rights. When the landowner subsequently sells or gives away his land, he is actually transferring this bundle of rights. However, there is a longstanding right to split off some of the rights from the bundle and sell or donate them separately from the rest. Often in the past, for example, one farmer would sell to another the right to cross a strip of his property to reach fields with no direct access. That strip would then be subject to a right or easement held by the other farmer and as a result might not be fully usable by the landowner.

Over the years, the separation of such rights has become more common as a land use control technique. Various agreements have been formulated whereby landowners sell, donate, or transfer limited rights from their bundle to private groups or public authorities. Sometimes such rights are called conservation easements or scenic easements. The more common generic term is "development rights" because the rights split off and transferred usually include most of the rights to develop the land.

There is no doubt that the community can purchase those development rights it feels it needs to control land use beyond the point permitted by the Constitution. It may even condemn such development rights under eminent domain laws and compensate an unwilling seller, although the public benefit derived from such strong action must be clearly demonstrated. But the purchase of development rights can be expensive, particularly if it is used as a stopgap in areas subject to heavy development pressures. An added cost, as in the case of publicly owned lands, is that the value of rights held by the community is removed from the tax rolls.

Despite these legal intricacies and the financial limitations, there is increasing interest in a wide range of approaches to development rights as a part of the community's land use controls. New approaches include donations, transfers, and other devices in addition to purchase of these rights.[154]

The donation of development rights is a valuable approach in cases

in which landowners are agreed that they would all benefit from restricting or preventing further development. Each owner deeds his rights to a public body or a private nonprofit preservation group. Landowners continue to use their property and can sell it, subject of course to those rights now held by the donee. Such donations can reduce the owner's property taxes and may be deductible as a charitable gift in computing Federal income taxes.

Some development rights donation agreements have been in force for many years. Residents of the Mill Creek Valley in suburban Philadelphia have had an agreement in effect for nearly 35 years; it withstood the pressures of surrounding suburbanization and nearby freeway construction and preserved the natural character of the valley.[155] Large portions of the Brandywine Valley in Delaware and southern Pennsylvania have been similarly set aside as permanent open space.[156] The donation approach has also worked in conservation areas in New England.[157]

Where donation of development rights does not appear possible, a community may wish to purchase and hold development rights when it desires to restrict development to a degree not permissible through regulation. The community can choose the amount of rights it wishes to purchase according to a variety of factors. In the case of some parcels, for example, it may be enough to buy only the rights to higher density development; in other cases, the right to prevent all further development might be purchased. A recent example of this selectivity is the proposed plan for the Brandywine Valley in Chester County, Pennsylvania. This plan calls for the Chester County Water Resources Authority to purchase development rights to the edge of the floodplain of the Brandywine River or to a distance of 300 feet, whichever is greater, and the rights to develop at density greater than 1 house on each 4 acres on wooded or steep slopes.[158]

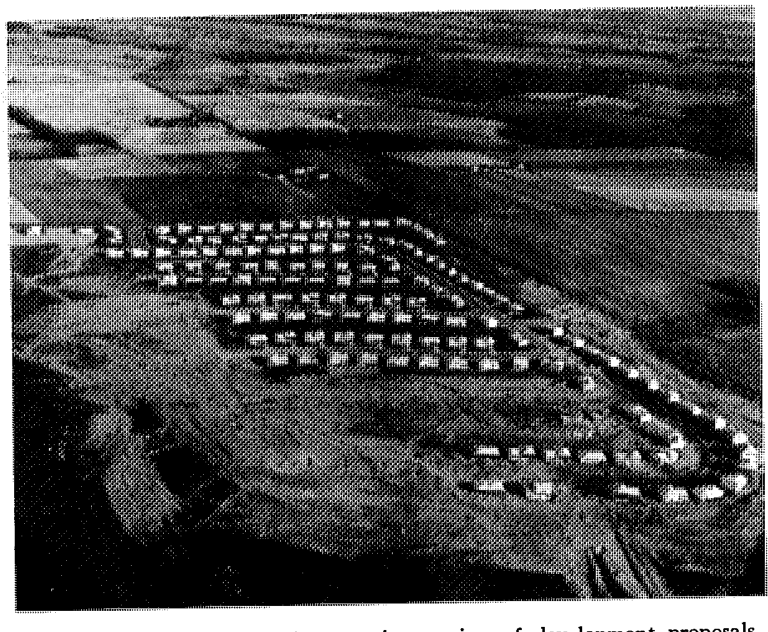
As with donation of development rights, their purchase is not a new and untested development. Such purchases have been used to protect wetlands and other environmentally critical areas and have also been used extensively around airports.[159] Nevertheless some public officials are still reluctant to purchase development rights on an extensive scale. One criticism is that development rights often cost nearly as much as titles to the land. This is indeed the case where efforts to purchase development rights are initiated after the land has come under the pressure of urbanization; in such circumstances, most of the value of the land derives from its development potential. On the other hand, the State of Wisconsin purchased development rights in rural areas adjacent to the Great River Road along the Mississippi River over 30 years ago for a few cents per front foot; today the road is fully protected from billboards and extensive development.[160]

Another criticism is that the purchase of development rights causes enforcement problems and makes the land difficult to manage.[161] But the Nature Conservancy, which has considerable experience in

the receipt and purchase of such partial estates in land, has found that the landowner continuing to live on the land is the best manager and law enforcement officer of all.[162]

An important new concept is "transferable development rights."[163] Traditional land use controls assume that the development potential of a site may be used only on that site. The new concept proposes to break this linkage between a piece of land and its development potential by permitting the transfer of the development rights to land where greater density will not be objectionable. In freeing the development rights for use elsewhere, the technique would avoid current inequities by enabling the owner of a restricted site to recoup lost economic values by selling the site's development potential.

Under this concept, as it is generally envisioned, all land would initially be assigned the same number of development rights per acre. Then a plan would lay out zones for low, medium, and high density development. Landowners in high density zones, needing more rights in order to build to permitted levels, would buy those rights from landowners in low density zones. Thus the development rights would be bought and sold on an open market. Any landowner could take part, but he could develop his land only to the degree that he had accumulated development rights and only to the extent permitted by



Many land use control devices—zoning, review of development proposals, development rights purchases, land banking, and timed development plans—are available to localities to help direct the pattern and pace of new growth and to reduce its adverse environmental effects.

the zone he was in. Unlike current zoning practices, the boundaries of the zones or the degree of development within a zone could not be changed.

There is still a great deal of uncertainty about the details of how such a system would work and the extent to which it would be associated with more traditional land use controls such as zoning. Some concrete proposals, however, are being developed.[164] Given the gaps in existing research and the obvious problems of implementing poorly conceived transfer programs, extensive investigation, research, and experimentation are necessary before such a system is widely adopted.

The public costs of such a program should be limited to organizing the development rights market and making sure it works. If the rights are transferrable only within a community, the tax base remains constant, for the increased tax payments of the purchaser of development rights will offset the reduced payments of the seller. One substantial benefit for the community is that land from which the development rights are sold is effectively preserved in low density or open space use in private lands without cost to the public.

Transfer of development rights has been attempted on a limited basis by some cities, and it has proven particularly useful in preserving historic buildings in neighborhoods under redevelopment pressure.[165] Such buildings may be saved if the owner can transfer the right to build a higher structure on the site to a nearby property he owns. In this way, he is permitted to build higher on the latter site in return for preserving the lowrise historic building on the former. This assumes, of course, that there are height restrictions in the neighborhood beyond which the developer wishes to build and that a building of such height is not undesirable.

Whether the development rights transfer approach should achieve wider application and even replace zoning and other traditional land use controls may soon become a major topic of debate. At this point, the transfer concept is still in its infancy. As with any other innovation, it will be widely adopted only if it is clearly proved superior to more traditional methods. However, some parts of the development rights transfer concept may prove useful in the long run. They may provide a way to alleviate the unfair "windfall" and "wipeout" effects brought on landowners by current land use controls.[166]

Land Banking—Another potential mechanism for public control over development is land banking. This approach involves the acquisition by the community of extensive undeveloped land surrounding the community with subsequent resale of parcels and tracts to developers in a way that effectively controls the rate and pattern of urbanization.

New communities such as Columbia, Maryland, and Irvine, California, demonstrate the simplest form of land banking. The developer acquires a large tract of undeveloped land, prepares a land use plan,

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and provides major infrastructure investments such as roads, sewers, and utilities. He then controls development of the community so that the construction of residences, commercial centers, recreational areas, and public facilities are efficiently staged and coordinated. In this way the community developer creates a more orderly growth process and is able at relatively low cost to preserve lands for future public facilities and for open space.

Public land banking schemes, though uncommon in the United States, are used in many other countries. Programs of land acquisition and banking have been implemented in Australia, Canada, Denmark, England, Germany, the Netherlands, Hong Kong, Israel, Norway, and Sweden.

Several examples bear particular mention. The English new towns have been built on land acquired for that purpose by public corporations which undertook the development, planning, land acquisition, and construction.[167] Sweden's municipal land reserves have particularly impressed urban American planners.[168] After World War II, Stockholm undertook a very aggressive program to control the process of urban growth, which resulted in attractive, well-planned suburban communities, separated by green space from the core city and from each other, and efficiently linked by public transportation and highways.

The applicability of much of this foreign experience to the American situation is limited.[169] However, land banking which has been in effect since the 1930's in the Canadian provinces of Alberta and Saskatchewan may be more directly relevant because of the similarity between U.S. and Canadian property laws and traditions. It is interesting to note that a Canadian Government task force studying the Saskatchewan experience found that the prices charged for housing in and around cities using land banking were significantly lower than those around comparable cities that had not adopted such a program.[170]

As with zoning, the economic effects of land banking depend on how it is administered. The act of withholding land from the market should increase land prices.[171] This escalation in land prices is particularly severe during the initial public acquisition of the land. After initial acquisition, land prices are determined essentially by the amount of land released for development. The initial inflationary effect can be avoided by purchasing land sufficiently distant from the urban fringe that it is not yet effectively a part of the urban land market and thus is much less expensive. However, such an approach would prevent land banking from having any significant short-range impact on the urban growth process.[172] The Swedish experience suggests that land for a reserve should be acquired at least three decades in advance of its anticipated development.[173]

Land banking undertaken nearer to urban areas can have a positive effect by assuring the development of previously passed-over parcels. Such parcels, leapfrogged by developers for larger and

cheaper tracts farther out, sometimes amount to a substantial proportion of the total urbanized area. By preventing such leapfrogging, land banking can force the filling in of passed-over land and create more efficient land use patterns, although the financial advantage of banking in advance of urbanization is lost to the public.[174]

There has been some experimentation in land banking in the United States, not only through recent new communities, but also in the creation of a few "greenbelt" towns during the 1930's and government towns such as Los Alamos and Oak Ridge during the 1940's. More important, a number of communities have implemented what amounts to "land banking" by advance acquisition of land later used for schools, open space, and highway corridors. While this does not result in control over large land areas, such policies appear to benefit localities in two ways. Needed land is acquired while it is still cheap, and prior knowledge of such public facility location permits more effective planning and more informed private development decisions.[175]

There remains strong interest in the possible use of more extensive land banking schemes.[176] Two Presidential Commissions, a special Congressional committee, and numerous other official, quasi-official, and private organizations have recently undertaken analyses of the problems of providing for more orderly urban growth.[177] Almost without exception, their reports call for the public acquisition of land in order to reduce the cost of public facilities and to guide and control urban development more effectively.

No-Growth and Slow-Growth Policies—As this chapter indicates, the interrelationships of community goals, economic forces, tax policies, and land use controls are extremely complex and little understood. As a result, citizens in many communities share a feeling that the development process is out of control, that decisions are made which benefit only the influential developers' interests, and that piecemeal changes are having an unpredictable cumulative effect on the quality of life.[178]

The reaction in many localities is a strong citizen effort to slow or stop growth. In its most extreme form, communities have decided that they want no more growth and will allow no more development.[179] Such an approach is futile as a long-term solution. Among other problems, it may deny some the right to a reasonable use of their land, a denial which is in violation of the Constitution unless the owner is compensated for his loss by the community. Few communities have the wherewithal to buy out all the development rights surrounding them. Such an approach also tends to have the effect of merely pushing growth elsewhere.

When such flat bans on development have been imposed for unlimited periods, they have run afoul of the courts.[180] On the other hand, there is at least some evidence that in those areas in which a community has imposed a temporary halt on development in order

to plan its future, the courts will be more receptive. In one recent Federal court case, a small town in New Hampshire, faced by a large seasonal home subdivision, rezoned the land to 6-acre minimum lots to halt the project until a town plan could be developed and adopted.[181] In upholding the community's right to call a halt to the development, the court emphasized the temporary nature of the locality's action, the relative size of the proposed development compared to the existing town population, and the fact that the action denied no one housing, since the proposed development was clearly for second homes.

Many communities have imposed moratoria on various phases of development. One recent study found that nearly one-fifth of all local governments surveyed had imposed some type of moratorium, most frequently on building permits.[182] Another type of moratorium often used is on new sewer connections. This is usually done upon the order of state health or water pollution control authorities to prevent overloading of treatment plant capacity. Over 200 such moratoria were in force during 1973.[183] They are generally upheld when challenged in court, being temporary and necessary for compliance with state and Federal water quality laws. There is usually a schedule for the construction of new treatment facilities which provides assurance that the moratorium will be lifted in the foreseeable future.

Some communities, however, have adopted such moratoria in a more open attempt to control rates or patterns of population growth.[184] Although the actions may well limit the amount of growth taking place in one community, that growth will probably occur somewhere else, perhaps with more adverse economic, environmental, and social effects. For example, if the moratorium prevents hookups to existing sewers, desirable in-fill development on previously skipped-over land cannot take place. This may contribute to continued urban sprawl by narrowing the development alternatives to single family housing on large lots with septic tanks, usually feasible only in undeveloped areas far from the central city. Alternatively, the moratoria may force developers to install "package treatment systems" which add to the cost of housing in the short run and create substantial maintenance and monitoring costs for the locality in the future.[185] In short, rather than controlling urban development, sewer moratoria can accelerate sprawl.

Sewage treatment moratoria can have other counterproductive impacts as well. For example, in Tacoma, Washington, the State Department of Ecology in May 1971 imposed a ban on further septic tank installation in order to prevent greater pollution of ground and surface water. But during the 4-month delay between the announcement of the ban and its implementation, builders stockpiled septic tank and building permits and built a great many units with septic tanks which might well not have been built otherwise.[186] A related phenomenon occurred in 1970 in Montgomery County, Maryland, when some areas of the county were placed under a moratorium

while others were not. A run on permit applications took place, and the development of the county was distorted by the high amount of construction in the unrestricted areas.[187]

Sewer moratoria can also have a serious effect on low and moderate income groups by tightening the housing market and increasing housing costs, since package plants and septic systems are costly and the latter require large lots.

The difficulties of sewer moratoria are succinctly stated in a report of the County Executive's staff in Montgomery County: "The results [of the moratorium] have been disappointing. The increase in sewage flows has not tapered off. The residential construction rate has actually increased . . . The price of housing, both rental and sale, has risen extraordinarily in recent years, making it increasingly difficult for people in lower and moderate income ranges to obtain housing in the county. The end result is that both water quality and socioeconomic problems have gotten worse." [188]

In contrast to these difficulties with no-growth policies, a number of new concepts of slow growth or timed development have been successfully implemented, usually by small communities with skilled land use planning staffs and progressive elected officials. The general approach of these communities has been to define a rate of expansion compatible with the desires of the community and projected growth of the region and to implement land use strategies to control new construction and direct it to designated areas in such a way that public services can be provided most efficiently.

The Town of Ramapo, New York, is perhaps the best-known example of the timed development approach.[189] The community has established a 17-year plan to accommodate and direct anticipated growth. The community evaluates development proposals on a point system that emphasizes the availability of public services, which are extended in planned stages. While it has been criticized for not providing sufficient low and moderate income housing, the Ramapo plan has been upheld in court as a reasonable exercise of community land use authority.

It is interesting to contrast the Ramapo decision with a recent California decision which threw out the plan of the town of Petaluma for limiting development to annual increments of 500 housing units, holding the plan to be a violation of the Constitutional right to travel.[190] The case is being appealed. Under the Petaluma plan, a competition is held each year to decide which proposed developments should be approved. As in Ramapo, a point system is used to evaluate development proposals. But one distinction worth noting is that the majority of the points in Petaluma are allocated to design and other subjective criteria, while in Ramapo the emphasis is on availability of public services readily identifiable in the plan.

In summary, it may be predicted that the efforts of communities to slow or stop growth will continue and probably spread. Among the important distinctions to be drawn are: (1) whether a proposed halt is temporary or permanent; (2) whether it is part of an attempt

by the community to get a grip on things or simply an effort to stop all growth; and (3) whether it is being done in the face of a relatively large influx of development. Efforts to use sewer moratoria or similar bans to stop growth, because of implementation timetables and enforcement difficulties, have not proven effective and may actually exacerbate some environmental, economic, and social problems. On the other hand, approaches which try to predict and accommodate growth through timed or staged development plans offer considerable promise and evidently can be accomplished within existing police power authority if carefully designed to assure the preservation of property rights.

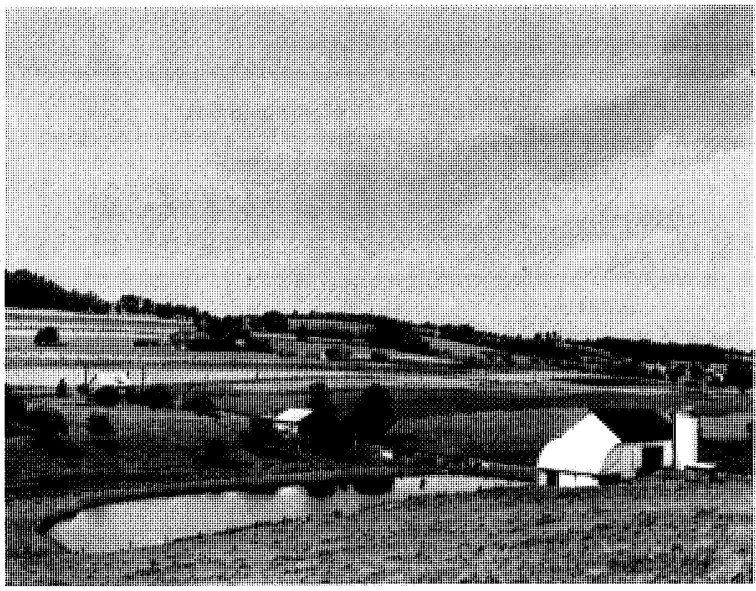
Preferential Assessment—Another land use control which has become popular in recent years is preferential tax assessments for certain types of real property. Preferential taxation is a method of lowering the tax burden on land such as farms or forests or historic districts which the community wishes to preserve by assessing at less than its full market value.[191]

Most often, preferential assessment programs are adopted in order to preserve current desirable uses of land.[192] Some states have adopted preferential taxation for reasons of equity after determining that farmers and other owners of open space had been paying higher property taxes in relation to public services received than other landowners.

But preferential taxation appeals to a wide range of groups with different goals, including farmers, environmentalists, large landowners, and even land speculators. As a result, 33 states have already adopted some form of preferential taxation, while others have it under serious consideration. (See Table 7.) However, there is some question as to the effectiveness of preferential taxation in accomplishing the desired goals. The best that can be said is that the effectiveness depends upon the goal sought and how the program is implemented.

Preferential assessment clearly does redistribute income, for it reduces the holding cost of land to the beneficiaries and requires increased taxes on others. Studies in California and Maryland have found that property tax rates may be increased 10 percent or more for property that is not afforded a preferential status.[193] Even if the payment per person is small, the aggregate payment may be large. A New Jersey study estimated that about $48 million in extra taxes were paid by nonfarmers in 1972 because of the preferential taxation law.[194] Two States, California and New York, recognizing possible loss of local tax revenues, have passed laws instituting reimbursement for localities which suffer a loss as a result of preferential assessment.

Whether or not the transfer of income resulting from preferential assessment is equitable depends upon one's definition of equity, who is paying the increased taxes, and who is receiving the benefits of



Over 30 states have enacted some form of preferential assessment for property taxation in order to protect farmlands, preserve open space, provide for recreation, or help control urbanization.

the lower assessment. Although most laws include some restrictions on who can benefit, the requisites are usually loose enough that any large landowner can qualify. Thus land speculators as well as bona fide farmers find it cheaper to hold land under a preferential taxation program.[195] To the extent that this is the case, preferential taxation may do little to preserve open space or current use. Nevertheless, about 40 percent of a group of New Jersey landowners who participated in a preferential taxation program indicated that it helped in allowing them to continue to farm, and at least one analysis concluded that the scheme did slow the conversion of agricultural land into urban uses.[196]

Studies in other states are less encouraging with respect to the land use impact of preferential assessment. An analysis in California indicated that land included under the State's Williamson Act, was, for the most part, more than 10 miles from the nearest incorporated area.[197] In such cases, farmland is likely to remain undeveloped, regardless of preferential assessment. In order to avoid this problem, some state laws restrict land eligible for preferential assessment to specific areas, which are usually those which are under greatest development pressure and the preservation of which is in keeping with land use plans. (See Table 7, column headed "predesignation.")

Preferential assessment, by lowering the costs of holding lands for future development, can also stimulate leapfrog development on

Table 7

State Preferential Assessment Programs

State	Eligibility criteria					Conversion controls	
	Agriculture [1]	Forest	General open space [2]	Special [3]	Pre-designation [4]	Rollback penalty [5]	Other penalty [6]
Alaska	●					●	
Arkansas	●	●					
California	●		●		●	●	
Colorado	●						
Connecticut	●	●	●		●[7]		●[8]
Delaware	●	●					
Florida	●		●				●
Hawaii	●	●	●	●		●	●
Illinois	●					●	●
Indiana	●						
Iowa	●				●[9]		
Kentucky	●	●				●	
Maine	●	●	●		●	●	●
Maryland	●	●		●[8]	●[10]	●	
Massachusetts		●					
Minnesota	●		●	●		●	
Montana	●					●	
New Hampshire	●	●	●		●[11]		●[8]
New Jersey	●					●	
New Mexico	●	●					
New York	●					●	
North Carolina	●	●				●	
North Dakota	●				●[9]		
Oregon	●					●	●
Pennsylvania	●	●	●		●	●	●
Rhode Island	●	●	●			●	
South Dakota	●				●[9]		
Texas	●					●	
Utah	●					●	
Vermont	●						
Virginia	●	●	●		●[12]	●	●
Washington	●	●	●			●	●
Wyoming	●						

[1] Agriculture—in addition to crop land includes pasture, nurseries, horticulture, and apiary.
[2] General Open Space—includes land used for outdoor recreation in general.
[3] Special—land devoted to a specific category such as golfing, country clubs, and planned development.
[4] Pre-designation—land which has been designated for a particular use by a city, town or county. To receive preferential assessment land must fall within such a designated area and meet other eligibility criteria.
[5] With the rollback penalty, if the land is converted from its preferred use, the

(Continued)

the urban fringe. This form of development is generally more wasteful and more land-intensive than that which is likely to occur naturally.

To meet this problem, most states have established conversion penalties or recapture provisions to reinforce the incentive to preserve the land in its current use. (See Table 7, column headed "conversion control.") These penalties most commonly take the form of a "roll-back" or a "deferred payment," requiring the landowner to pay an amount equivalent to several years' worth of tax savings, sometimes with interest, if he develops the land. They can also take the form of a conveyance tax whereby the owner pays some percentage of the land value if he sells his property to a nonfarmer or decides to develop it himself. If such penalties are sufficiently harsh, they will reduce the profitability of developing the land; but they will also reduce participation by landowners in the program.

A step beyond the penalty provision is a requirement that any landowner desiring preferential assessment sign a contract to keep his land undeveloped for a certain number of years. In California, the Williamson Act requires a contract of at least 10 years. It is automatically renewed annually unless either party to the contract requests nonrenewal. If the contract is not renewed, the assessment is gradually increased to the market value as the number of years remaining in the contract decreases. Because the contract effectively restricts those who might seek to sell their land in the foreseeable future, owners near urbanizing areas are less likely to take advantage of the preferential treatment than owners of more remote land. The contract technique is the exception, however. Some other states use informal negotiation between the landowner and government. The vast majority use neither technique but allow any landowner meeting legislated requirements to enlist in and withdraw from the program at his own discretion.

At this point it must be concluded that the various state preferen-

(Continued)

owner is required to pay an amount equal to several years worth of the additional property taxes he would have had to pay had his property not received the benefit of preferential assessment.

[6] "Other Penalty" is usually the assessment of interest charged on the rollback penalty.

[7] In Connecticut, open space land must be recommended for preservation and designated open space by a municipality's planning commission in its plan of development.

[8] Connecticut and New Hampshire have adopted a tax, similar to a conveyance tax, which is imposed at the time the land use is changed.

[9] In Iowa and North Dakota the land must be within the limits of a municipal corporation and in South Dakota it must be within a school district.

[10] In Maryland, the land to be assessed and taxed as planned development land must be in an area covered by a current master plan or otherwise designated as a satellite city or town.

[11] Open space must be pre-designated by a town or city, and floodplains by the Flood Plain Commission.

[12] In Virginia the land must be designated for its use (as agricultural land, timber land, etc.) in a town or county land use plan.

Source: Economic Research Service, U.S. Department of Agriculture, *State Programs for the Differential Assessment of Farm and Open Space Land* (1974).

tial assessment programs have had mixed results, at best, in achieving their objectives. Because of the popularity of this land use control technique and the controversy over how it can be made more effective, the Council has contracted with the University of Pennsylvania to undertake an evaluation of preferential assessment as it is now being carried out by states and to develop recommendations on improving its effectiveness as a growth control mechanism.

Open Space as a Land Use Control—Traditionally, open space has been considered a beneficial public expenditure in itself; there has always been substantial interest in preserving open space for visual amenity, outdoor recreation, natural resource conservation, flood prevention, and preservation of agricultural lands. But it is also recognized as a mechanism for the containment and guidance of growth.[198] The purpose of greenbelts, long used in England and other foreign countries, was to contain urban growth by preserving a belt of open space around the city.[199] But this approach was thought by Americans to be too costly.

The United States, of course, has never had a shortage of open space. The basic issue has been its location with respect to urban areas—the amount of open space that should be set aside and preserved within or near cities.[200] The proposal to preserve large wedges of open space in metropolitan areas has had some support in this country.[201] Such wedges serve to direct urban growth into corridors radiating from the central city. These corridors enable more efficient allocation of mass transit and other services than typical sprawl development. But few cities have been able to implement such plans.

Of the several methods for preserving open space, the most straightforward is public acquisition by which government takes title to the land and provides public access. But public acquisition has certain limitations. It is costly; it removes land from the tax base; it brings operation and maintenance costs; and it assumes that all open space should be put into public use. For these reasons, communities are turning to other techniques to supplement the purchase of land where public access or full public ownership does not appear necessary or even desirable.

The concepts of development rights and preferential assessment discussed above may help to accomplish this goal. These and similar devices can be used to acquire necessary rights through donation, purchase, or transfer to other land. In addition, many jurisdictions are finding that certain tracts can be preserved from development without public acquisition because they are in areas such as floodplains, where development would endanger human life, and thus fall under the police power authority to regulate land use for the public welfare.[202]

If the land must be purchased outright, the budget may allow only the acquisition of land which is remote from urban areas, not read-

ily accessible, and often not very attractive. The "best land," that is, the most suitable in terms of the community's needs, tends to be expensive. Nevertheless, a case can be made for buying it. There is increasing evidence that open space preservation is economically beneficial to all—the developer, the resident, and the local government.

Developers in increasing numbers are coming to understand this. If a developer "creates an outstanding environment, saves the trees, has a good street pattern, and then adds a pool and a modest recreation area, he might easily get $500 to $1,000 more per house than he would in an ordinary subdivision." [203] Developers who preserve open space and natural cover on one project often find it so successful that in their next development they tend to provide even more.[204]

The development of park facilities generally increases the value of surrounding realty; there is even some evidence that the increase in tax revenue can more than pay for the cost of the parks.[205] It is common practice throughout the United States for appraisers representing the Federal Housing Administration to place a higher value on house lots if the development contains a park or if it is near a public park.[206] Moreover, "today's home buyer is looking for features beyond the confines of the house and lot. . . . In the vicinity of park and recreation areas enhanced values of building sites up 15 to 20 percent . . . are not uncommon experiences." [207]

Individual case studies offer striking examples of the value of open space and parks. The classic study in Elizabeth, New Jersey, covering the period 1922 to 1939, showed that the assessed value of properties within a quarter-mile of the Warinano Park increased over six times while assessments in the city as a whole increased only two and one-half times.[208] Another study done in Oakland, California, compared two similar neighborhoods near parks and found that the mean assessment of property adjacent to the parks was from $500 to over $1,000 more than land a block or two away.[209] The study concludes that "parks do hold the value of their surrounding lands. Not only do parks influence assessed valuations, they also have an effect on how residents perceive their neighborhoods, and consequently a pride in the area is fostered by the presence of a park." [210]

A community gains other economic benefits from open space programs. Land set aside as open space will not have to be supplied with public service infrastructure. To the extent that open space directs and compacts development, the savings to the community are large. In a study done of the San Francisco Bay area, it was estimated that a carefully planned regional open space program, by reducing sprawl and channeling development, could reduce the growth of the city in coming decades by 327 square miles. The study estimated that reduced municipal costs for installation and maintenance of services such as roads, water, gas, and electricity would save $318 million; it concluded that the total cost savings would

be of the same order of magnitude as the cost of purchasing the land.[211]

The timing, degrees of control purchased, and location of the open space appear to be the most crucial factors determining success in using open space as a growth control device. If too much of the wrong kind of land in the wrong place is preserved, the result may be no more than a few parks surrounded by poorly planned communities. Presumably the most suitable land for preservation is that land which fulfills the greatest number of open space functions. But often, as mentioned earlier, the land which is most suitable for and most in need of preservation is also the most expensive.[212] The resolution of this dilemma is not easy.

Controls as Stimulants

A theme which consistently reappears throughout this section is that controls can, under particular circumstances or if instituted in particular ways, have effects contrary to the purpose for which they were adopted.

Limiting growth in one community may only push it to a less desirable location; the adoption of a preferential taxation scheme to preserve open space may primarily benefit land speculators; and sewer moritoria may result in more septic tanks causing more water pollution. Any of these actions taken to better control land development or improve environmental quality, if done wrong, can have the opposite effect. Just as the stimulants discussed in the second section of this chapter can be used as land use controls if they are properly planned and staged, the controls discussed in this section can become stimulants.

Once this interrelationship is understood—that stimulants like highways and sewers can be used to control growth, and that controls like zoning and preferential assessment can be used to stimulate the development of certain areas—a community can begin to formulate a strategy for land use regulation. Not all the stimulants will be under its authority; localities have little say about interstate highways or Federal tax policies, for example. And not all of the possible control mechanisms will be feasible, but at least some will be available. By using legal authority in these ways, most communities should be able to overcome uncertainty and frustration over growth and replace it with more confidence in the ability to influence where, how, and when development will occur.

Conclusion

This chapter has identified and briefly discussed some of the major land use issues that the United States faces today. The focus is on issues of land development, particularly in urbanizing areas. Less

attention has been given to other important land use questions, including the definition and protection of "critical environmental areas," the preservation of wilderness areas, and the land use impacts of U.S. agricultural policies.

But the chapter has provided some indication of the importance and complexity of land use as an environmental issue. It shows how stimulants to growth can become controls of growth; how land use controls act as stimulants to development; and how pollution control programs may result in land use changes that in turn tend to increase pollution. Many actions undertaken with the best of intentions may, because of the way they affect the land, result in land use changes that are perverse in terms of the original goals.

The way in which some of these factors interact can be seen by looking at the relationship between automobile use and land use. We seem to have become an auto-dependent nation. There are many reasons why this has occurred, starting with the development of a new technology which made autos available to nearly everyone and allowed people much greater flexibility in their travel habits and their choice of residential location. Given our general preference to live in rural areas adjacent to urban centers, people who could afford to do so moved out of town and commuted to work. This made the city a less attractive place to live as cars with their pollution, congestion, and noise increasingly disrupted the stability of residential neighborhoods they passed through. These effects, combined with increasing social and economic problems in the central city (both also linked to the departure of the more affluent residents to the suburbs), accelerated the exodus, and more and more people moved farther and farther out, driving longer and longer distances in order to obtain their small piece of rural life.

As the suburbs attempted to adjust to this trend, they found it was necessary to require more parking, wider streets, and greater separation of congestion-inducing facilities in order to accommodate the automobile and to mitigate its adverse effects on residential areas. All of these adjustments, of course, resulted in more auto use. It is not uncommon now for the suburbanite to have to drive several miles to buy a loaf of bread.

This is not to say that we are wed to ever-expanding metropolitan sprawl. In fact, recently there have been some signs that this trend may be slowing and perhaps even reversing itself. Mass transit ridership is up in many metropolitan areas. People are returning to the central city, as noted in the CEQ's 1973 Annual Report. In mid-1974, whether because of high gasoline prices, limited availability of mortgages, or a deeper change in values, the market for development on the urban fringe and for leisure homes is slowing somewhat. The overall effect, taken with efforts to control air and water pollution and better land use controls at the local level, has been the emergence of significant new opportunity to look at how growth and change can best be accommodated.

14. Anne M. Vitale and Pierre M. Sprey, *Total Urban Pollution Loads: The Impact of Storm Water,* study done by Enviro Control, Inc. for the Council on Environmental Quality (National Technical Information Service No. PB–213–730, 1974).
15. Sanitary sewage pollutants indicated are those remaining after tertiary treatment of the sewage. With only secondary treatment, which is more common, the volume of pollutants would be increased 5 to 10 times.
16. Brian Berry *et al., supra* note 12, at 226, 258–259; Clifford R. Bragdon, "Noise Control in Urban Planning," *Journal of the Urban Planning and Development Division,* American Society of Civil Engineers 99: 15–23, March 1973; Samuel R. Lane, *Freeway and Highway Traffic Noise: An Information Base for Urban Development Decisions,* prepared by the Urban Mass Transportation Study, School of Architecture and Urban Planning University of California, Los Angeles for the Urban Mass Transportation Association (NTIS No. PB204–434).
17. Brian Berry, *supra* note 12, at 413.
18. *Id.,* p. 424.
19. Alan M. Vorhees and Associates, Inc., *Reston Transportation Study,* prepared by Alan M. Vorhees and Associates, Inc. for the Urban Mass Transportation Administration (NTIS No. PB197–836, 1970); John B. Lansing *et al.,* "Planned Residential Environments" (Ann Arbor: Institute for Social Research, University of Michigan, 1970).
20. Salvatore J. Bellom et al., *Factors, Trends and Guidelines Related to Trip Length,* National Cooperative Highway Research Program Report 89 (Washington, D.C.: Highway Research Board, 1970); Wilfred Owen, *The Accessible City,* (Washington, D.C.: The Brookings Institution, 1972).
21. *The Costs of Sprawl: Detailed Cost Analysis, supra* note 5 at 146; F. P. Linaweaver *et al.,* "Summary Report on the Residential Water Use Research Project" *American Waterworks Association Journal* 3: 267–282, 59, March 1967.
22. *The Costs of Sprawl: Detailed Cost Analysis, supra* note 5 at 148–151.
23. Real Estate Research Corporation, *supra* note 5 at 152–153; William T. Baker, "An Evaluation of the Traffic Conflicts Technique," Highway Research Record #384 *Traffic Record* (Washington: Transportation Research Board, 1972); J. A. Fee et al., *Interstate System Accident Research Study—1,* prepared for the Federal Highway Administration (Washington: U.S. Government Printing Office, 1970).
24. *The Costs of Sprawl: Detailed Cost Analysis, supra* note 5 at 50 and 76–77; John Lansing et al., *supra* note 19.
25. *The Costs of Sprawl: Detailed Cost Analysis,* p. 154; Oscar Newman, *Defensible Space: Crime Prevention through Urban Design* (New York: MacMillan Company, 1972); Southern California Association of Governments, *Handbook of Crime Prevention Bulletins—Crime Prevention through Physical Planning* (Los Angeles: Southern California Association of Governments, 1971).
26. The Commission on Population Growth and the American Future, *Population Distribution and Policy,* Vol. 5. (Washington, D.C.: U.S. Government Printing Office, 1972), p. 620.
27. But costs *per acre developed* may increase. Most of the above results pertain to the costs of providing a given number of dwelling units. *The Costs of Sprawl* also includes an analysis of the costs of developing a given parcel of land, in which the number of dwelling units constructed on a site increases with the higher density neighborhood types. Because there are more dwelling units, the economic and several environmental costs associated with development of a given site tend to increase with the higher density development patterns, even though the cost per dwelling units decreases.

28. New Jersey County and Municipal Government Study Commission, *Housing and Suburbs: Fiscal and Social Impact of Multi-Family Development* (Trenton: New Jersey County and Municipal Government Study Commission, 1974).
29. Richard L. Ragatz Associates, Inc., *Recreational Properties: An Analysis of the Markets for Privately Owned Recreational Lots and Leisure Homes,* prepared by Richard L. Ragatz Associates, Inc. for the Council on Environmental Quality, the U.S. Department of Housing and Urban Development, and the Appalachian Regional Commission, National Technical Information Service, PB–233 148/AS (Springfield, Va., 1974).
30. A study in preparation by the American Society of Planning Officials with the assistance of the Conservation Foundation, the Urban Land Institute, and Richard Ragatz, University of Oregon. It will be made available through the Council on Environmental Quality, the U.S. Department of Housing and Urban Development or the U.S. Government Printing Office.
31. William E. Shands, *The Subdivision of Virginia's Mountains: The Environmental Impact of Recreational Subdivisions in the Massanutten Mountain-Blue Ridge Area, Virginia—A Survey and Report,* prepared by Central Atlantic Environment Center for the Council on Environmental Quality and the U.S. Department of Housing and Urban Development (Washington, D.C.: Central Atlantic Environment Center, 1974).
32. Council on Environmental Quality, *Environmental Quality: The First Annual Report of the Council on Environmental Quality* (Washington: U.S. Government Printing Office, 1970), p. 193.
33. R. B. Rainey, Jr., *Seattle's Adaptation to Recession,* prepared by The Rand Corporation and the Institute of Governmental Research of the University of Washington for the National Science Foundation under contract No. GI–29763 (Santa Monica: Rand, 1973); Roger Bolton, *Defense Purchases and Regional Growth* (Washington, D.C.: The Brookings Institution, 1966); Gerald Breese *et al., The Impact of Large Institutions on Nearby Areas* (Beverly Hills: Sage Publications, 1970).
34. A study in preparation by the National Park Service and the Office of Environmental Affairs of the U.S. Department of Transportation, Study of Transportation Alternatives to Parks, Recreation Areas, Historic Sites, and Wildlife Refuges, to be available through the National Park Service and the Office of Environmental Affairs of the U.S. Department of Transportation.
35. See, for instance, Jane Jacobs, *The Death and Life of Great American Cities* (New York: Random House, 1961); Martin Anderson, *The Federal Bulldozer* (Cambridge: MIT Press, 1964).
36. See, for example, Stephen Gurko, "Federal Income Taxes and Urban Sprawl" *Denver Law Journal* v. 48:329, 1972; and Richard E. Slitor, *The Federal Income Tax in Relation to Housing,* prepared for the National Commission on Urban Problems (Washington, D.C.: U.S. Government Printing Office, 1968).
37. Internal Revenue Code Sections 163 and 164.
38. Internal Revenue Code Section 167.
39. Bruce Leppla, Tax Incidents Contributing to the Growth of Condominium and Cooperative Housing: A Summary of Recent Developments, prepared by the Urban Institute for the Council on Environmental Quality under contract No. EQ4ACO31 (mimeograph).
40. Internal Renveue Code Section 167(a)(-1).
41. Internal Renevue Code Section 167(a)(b)(c).
42. Stanley W. Penn, *Wall Street Journal,* July 17, 1961; R. Slitor, *supra* note 36 at 38; Paul B. Anderson, *Tax Factors in Real Estate Operations* (Englewood Cliffs: Prentice Hall, Inc., 1956).

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43. Council on Environmental Quality, *The President's 1973 Environmental Program* (Washington, D.C.: U.S. Government Printing Office, 1973), pp. 305–318.
44. Stephen Gurko, *supra* 36 at 346; John A. Prestbo, "Sprawl of Cities Stirs Fears that Agriculture will Run out of Space," *Wall Street Journal,* July 20, 1971, p. 1, col. 6.
45. R. L. Ragatz, *supra* note 29.
46. Internal Revenue Code Section 167(a)(1)(2); Internal Revenue Code Section 162(a)(2).
47. Internal Revenue Code Section 1014(a).
48. Land Use Center, A Proposal for Investigating the Land Use Effects of Federal Tax Policy, prepared by the Land Use Center of the Urban Institute for the Council on Environmental Quality, 1974 (mimeograph.)
49. For general background concerning the valuation of open land at full market value see the *Congressional Record,* S8981–S8986, May 28, 1974.
50. *Congressional Record,* S3541, May 28, 1974. This bill would value historic places, farmland, woodland, and open space lands at their current use value.
51. Richard E. Slitor, Taxation and Land Use, paper delivered before the Forty-Fifth meeting of the American Assembly on Land Use in America held at Arden House, Harriman, N.Y., April 18, 21, 1974. Proceedings in publication.
52. 42 U.S.C. 1857 *et seq.,* as amended by the Air Quality Act of 1967, P.L. 90–148; by the Clean Air Act Amendments of 1970, P.L. 91–604; by Technical Amendments to the Clean Air Act, P.L. 92–157, Nov. 18, 1971; and by P.L. 93–15, April 9, 1973.
53. 33 U.S.C. 1151 *et seq.*
54. For a similar analysis of land use patterns resulting from ambient air quality, new source, and non-degradation regulations, see F. Bosselman et al., "EPA Authority Affecting Land Use," report submitted to the Environmental Protection Agency under contract number 68–01–1560, March 12, 1974.
55. 40 CFR 51.14.
56. 40 CFR 52.22.
57. 40 CFR 52.21.
58. 40 CFR 60 § 60.1 *et seq.*
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60. A concurring analysis projects energy facility siting, particularly mine-mouth location on major coal resources, in the western states. Harbridge House, Inc. "Key Land Use Issues Facing EPA," report prepared for the EPA Office of Planning and Evaluation by Harbridge House, Inc. (February 1974).
61. *Supra* note 55.
62. At a time when we have recognized that energy supplies are scarce, it is also disturbing that the regulations could in the long run result in a relative increase in energy consumption.
63. Under the proposed regulations the facilities that are to be reviewed within the SMSA's for impact include: new roads and highways expected to carry an average daily traffic volume of 20,000 or more vehicles per day within 10 years of construction, and modified roads expected to increase existing average daily traffic volume by 10,000 vehicles or more; and any new or modified airports expected to increase scheduled operations by 50,000 aircraft per year or have an increase of 1.6 million or more passengers per year; any new facility which includes parking for 1,000 cars or more or any modified parking facility which increases parking capacity by 500 cars or more. Outside SMSA's, facilities that are to be reviewed for impact include those having new parking capacity of 2,000 or more cars or modified capacity of 1,000 cars. For an analysis of

the impacts of each type of facility (shopping centers, sports stadiums, airports and highways, parking lots, and garages, recreational centers and environmental parks, and commercial or industrial development) see Harbridge House, Inc., *supra* note 60.

64. Even if no modifications of the plan are required of the developer, the time involved in obtaining a permit will add to the cost of developing facilities which are covered by the regulations. The importance of the time factor has been supported by initial findings on developer decision-making in a study on the effects of complex source regulations on the development process undertaken by Harbridge House, Inc. for EPA, *supra* note 60.
65. 40 CFR 51 and 52.
66. 39 Federal Register, 37419 (1974).
67. See *supra* notes 52 and 53.
68. P.L. 92–500, Sections 301–303, October 18, 1972.
69. *Ibid.*
70. P.L. 92–500, Section 208(b)(2)(C)(iii).
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72. This is indeed the major thrust and conclusion of the Bosselman study, *supra,* note 54, at 183–184.
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79. U.S. Environmental Protection Agency Region III, Draft Environmental Impact Statement: Valley Forge Area Wastewater Treatment Facility, Chester County, Pennsylvania (Philadelphia: U.S. Environmental Protection Agency Region III, 1973).
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148. See *supra* note 121.
149. Bosselman and Callies, see *supra* note 143.
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166. For a more complete discussion of this relationship in the case of Chicago see *supra* note 154.
167. See Peter Hall et al., *The Containment of Urban England* (London: Political and Economic Planning, 1973) 2 vols.; Kermit Parsons, *Public Land Acquisition for New Communities,* prepared for the Center for Urban Development Research, Cornell University (Ithaca: Cornell University, 1973).
168. Shirley S. Passow, "Land Reserves and Teamwork in Planning Stockholm," *American Institute of Planning Journal* XXXVI, May 1970; and Goran Sidenbladh, "Stockholm: A Planned City," *Scientific American,* 213: 107–118, September, 1965.
169. See Sylvan Kamm, "Land Banking: Public Policy Alternatives and Dilemmas," (Washington, D.C.; Urban Institute, 1970), for a discussion of the applicability of foreign experience with land banking polities to the United States.
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179. Petaluma, California and Ramapo, New York are examples of communities that have adopted such policies. For discussions of these examples see Herbert M. Franklin, *supra* note 144; and Herbert M. Franklin, Memoranda 74–2 and 74–4 (Washington, D.C.: Potomac Institute, 1974).
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181. *Steel Hill Development Inc.* v. *Town of Sandbornton,* U.S. Court of Appeals for the First Circuit, No. 72–1234, November 24, 1972 as discussed in Herbert M. Franklin, Memorandum 73–1 (Washington, D.C.: Potomac Institute).
182. Steve Carter et al., *supra* note 1.
183. Rivkin/Carson, Inc., *The Sewer Moratorium as a Technique of Growth Control and Environmental Protection,* prepared for the U.S. Department of Housing and Urban Development (NTIS PB230–293/AS, 1973), pp. 14, 15.
184. *Id.,* pp. 1–4.
185. *Id.,* p. 26.
186. See "Sewer Moratorium Case Study: Hagerstown, Maryland," and "Sewer Moratorium Case Study: Chambers Creek-Clover Creek Basin (Tacoma, Washington)," prepared by Municipal Permits and Operations Division, Office of Water Program Operations, U.S. Environmental Protection Agency (unpublished drafts, 1973).
187. *Ibid.*
188. Rivkin/Carson Inc., *supra* note 183, pp. 25–27.
189. Donald H. Elliott and Norman Marcus, "From Euclid to Ramapo: New Directions in Land Development Control," *Hofstra Law Review* 1: 56, Spring, 1973.
190. See *Construction Industry Association of Sonoma County* v. *City of Petaluma,* No. C–73–0763–LHB as cited in Herbert M. Franklin, *supra* note 179.

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APPENDIX

Recent State Land Use Legislation

The following is a summary, as of July 1974, of recent State land use legislation prepared by Land Use Planning Reports.*

Alabama—A bill to establish a study group to develop land use legislation recommendations has been proposed by the Land Use Legislative Committee. The state has a Coastal Area Act, a strip mining law, a property tax that permits some agricultural land protection, and has delegated planning and zoning authority to localities.

Alaska—As part of a "state strategy" Alaska is developing a comprehensive planning process that will include land use plans. Legislation to implement the strategy is expected to be introduced in the 1975 legislature. The Federal-State Land Use Planning Commission for Alaska is working with the state on the strategy and on planning for use of the 97 percent of the state's area owned by the Federal Government.

Arizona—The Arizona Environmental Planning Commission is conducting public hearings to gauge public attitudes toward state land use programs. It is to report recommendations to the 1975 legislature. Arizona has a power plant siting law, traditional local planning and zoning controls.

Arkansas—A major committee appointed by the governor is expected to report in October on general or specific proposals for land use legislation. Arkansas has a strip mining law and a "Utility Facility Environmental Protection Act." Local zoning and planning controls are little used, except in cities.

California—California has no single comprehensive land use plan. But several programs cover a total of about 75 percent of the state. The most important is the California Coastal Zone Conservation Act that requires permits for development along the coast. A land use bill (A.B. 2978) and a critical areas bill (A.B. 2979) are being considered by the legislature now; a strong power plant siting bill was passed this year; the 1965 Williamson Act is designed to preserve agricultural land and open space; and localities have full zoning and planning authority.

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*This summary is based upon a report published by Land Use Planning Reports entitled *A Summary of State Land Use Controls—July 1974* (Washington, D.C.: Plus Publications, 1974).

Colorado—A new state law (H.B. 1041) went into effect May 17 giving the state control over development activities of statewide interest. Colorado has a relatively weak strip mining law, has a law permitting assessment of some agricultural land on its use value, and enacted a bill (H.B. 1034) this year to clarify the full zoning and planning controls now available to localities.

Connecticut—The state is conducting public discussions on a proposed Plan of Conservation and Development with legislative action on resultant proposals expected in 1975. The plan will probably call for local land use controls with state guidance. Agricultural land is taxed at current value and a conveyance penalty tax is assessed.

Delaware—A committee called Delaware Tomorrow is to look at growth and land use. In the coastal zone the state has banned heavy industry within 2 miles of the coast and state permits are required for other coastal uses. The state has a preferential assessment law for agricultural land. Each county has a planning and zoning commission.

Florida—The Florida Land and Water Management Act of 1972 authorized Florida's statewide land use policy. It provides considerable state control of critical areas and development of more than one-county interest. Florida has a preferential assessment tax for agricultural lands. Localities were given full zoning and planning authority in 1968.

Georgia—Vital areas bills (H.B. 1677 and S.B. 557) were defeated by the legislature this year. The state now controls activities in wetlands. Localities have full planning and zoning authority.

Hawaii—Hawaii enacted the first state land use program in the Nation in 1961. It zones the state into four land categories. At the legislature's direction Hawaii is now developing a 10-year growth policy. Coastal zone and other controls are bound into the state land use program.

Idaho—Four bills (S. 1434, S. 1328, S. 1376, and S. 1377) that would have provided a comprehensive land use program were defeated this year by one vote in the Senate. The state has a strip mining law. Localities have full planning and zoning powers.

Illinois—Three land use bills (H.B. 1123, S.B. 975, and S.B. 802) were introduced this year but went nowhere. The state does have a strong strip mining bill, a deferred taxation scheme for preserving agricultural land and open space, and full planning and zoning authority in its localities.

Indiana—A comprehensive land use bill was introduced and withdrawn this year. Indiana was the only eligible state not applying for Federal coastal planning grants in fiscal 1974. The state has a fairly strong strip mining bill, taxes agricultural land on a preferential basis to preserve farmland and open space, and gives full planning and zoning authority to localities.

Iowa—A comprehensive land use bill (H.B. 1422) was passed by the House this year but was rejected by the Senate. Ninety-five percent of the land is in agriculture; agricultural land is assessed at use value.

Kansas—A legislative committee and an advisory committee of state officials, scholars, and citizens are attempting to identify land use issues. Localities have full zoning authority.

Kentucky—A Land Use Planning Council was created this year by the state legislature and will report to the 1976 biennial legislative session. The state has a strong strip mining law, a new power plant siting law (H.R. 438), use-value assessment with deferred taxation to preserve agricultural land, and full local planning and zoning authority.

Louisiana—The Office of State Planning is drafting a growth and conservation policy as a first step toward a state land use policy. A special commission has proposed development of a coastal zone plan. Agricultural land can be assessed on its use value. Although localities have planning and zoning authority, planning is still relatively new around the state.

Maine—A site selection act requiring a state license for major development, a zoning control act for shoreland, state regulation of unorganized areas (over half the state), and registration and regulation of critical areas constitute most of the state land use program. Maine has deferred taxation for agricultural land and full authority for localities to plan and zone.

Maryland—Enacted this year was a critical areas bill (S.B. 500) that allows the state to add to a list of critical areas designated by localities and the state to intervene in local regulatory proceedings relating to such areas. A coastal zone planning bill was killed this year. The state has strong power plant siting and strip mining laws and an advanced use-value tax for preserving agricultural land. Localities are quite advanced in using full planning and zoning authority.

Massachusetts—There are proposals in the legislature for a bill (H. 5567) that could lead to a statewide land use program and a more comprehensive coastal zone bill. A power plant siting law was recently enacted. Localities have full planning and zoning authority.

Michigan—A land use bill (H.B. 5055, renumbered H..B. 6097) was killed by the House by one vote this year. Power plant siting bills were also killed. An agricultural Land and Open Space Act was passed this year allowing 10-year contracts with the state. Michigan has perhaps the toughest state land sales regulation law.

Minnesota—The Critical Areas Act of 1973 authorizes the state to identify areas, including coastal zones, that would be damaged by uncontrolled development. The state has a 1973 power plant siting law and a deferred tax for preserving agricultural land. Localities have fairly advanced zoning and planning authority.

Mississippi—A state Task Force on Growth is attempting to coordinate planning and set goals for the state. Local zoning and planning have been little used.

Missouri—Several state agencies are working on a report on growth and its impact on critical areas. The state has a strip mining law. Only 22 of 114 counties have enacted planning or zoning ordinances.

Montana—The Governor vetoed a bill (S.B. 625) this year to establish a State Department of Planning. The department would have begun developing a statewide planning process. The state has a tough strip mining law, a 1973 Utility Siting Act, and a 1973 law providing preferential assessment for agricultural land.

Nebraska—A state resolution (L.R. 148) by the legislature directs that hearings and studies be conducted to develop land use legislation. The legislature this year passed a use-value assessment act for agricultural lands and an act to forbid interpreting comprehensive plans as requiring compliance with zoning ordinances.

Nevada—The state Land Use Planning Act of 1973 is called a "mini-Jackson bill" after the U.S. Senate-passed bill. A referendum goes before the voters this year on preferential assessment for agricultural land. The state will impose a master plan and zoning regulations on any county not enacting them by July 1, 1975.

New Hampshire—A bill (H.B. 22) to identify critical environmental areas was defeated this year. An Open Space Land Use Commission and the State Planning Office continue to work on land use recommendations. The state has a power plant siting law and has use-value assessment for agricultural land. Few counties have operating planning commissions, and where they do operate they are weak.

New Jersey—In February a state planning task force submitted a report that is expected to lead to statewide legislation. Some land uses in the coastal zone are regulated by the state under a 1973 law. A 1964 Agricultural Assessment Act slowed the rate of urbanization of farmland significantly. The entire state is incorporated, and the 567 municipalities have zoning and planning powers.

New Mexico—With no statewide land use policy, the legislature voted this year to match Federal land use planning grants if they were available. The legislature also repealed the state's Environmental Quality Act of 1972. The state has a strip mining law, preferential assessment for agricultural lands, and authority for counties to regulate subdivisions.

New York—The New York State Environmental Plan, the Adirondack Park Agency, the Development Plan for Private Lands, and coastal zone authority give the state wide-ranging influence over land use. The state also has a power plant siting law, a strip mining law, a complex agricultural preservation law, and a mix of state and local control of zoning and planning.

North Carolina—A Land Policy Act and a Coastal Areas Management Act were passed this year. The land policy measure lays the foundation for a future land use process while the coastal measure requires land use controls along the coast. Full zoning and planning authority were given localities 4 years ago.

North Dakota—Land use bills are expected to be introduced in the legislature next year. A 1970 strip mining law was stiffened considerably last year. Within corporate limits, agricultural lands can be taxed according to their use value.

Ohio—A measure affecting key facilities was introduced this year. The state has a strong strip mining law, a one-stop permit power plant siting law, a law (S. 423) enacted this year providing use-value assessment of agricultural land, and full planning and zoning authority for localities.

Oklahoma—A Technical Land Use Advisory Committee is assisting in preparations for meeting a Federal land use bill. The state has a strip mining law and a variety of local land controls.

Oregon—A comprehensive land use measure (S.B. 100) was passed in 1973. Implementation is now going on. Oregon has a power plant siting law and a use-value assessment law for agricultural land. Other land use related programs are covered by S.B. 100.

Pennsylvania—An interagency task force is developing legislative proposals for introduction in the 1975 legislature. The state has perhaps the toughest strip mining law in the country. Voters in a 1973 referendum authorized the legislature to write laws to preserve agricultural land, but the legislature has not acted. Planning and zoning controls have been adopted for the most part by localities.

Rhode Island—The Department of Administration is developing a comprehensive plan for the state, and from it specific land use proposals should come for next year's legislature. A state permit system now regulates some activities in the coastal zone. The state permits use-value assessment for agricultural land with a rollback tax penalty.

South Carolina—A governor's committee recommended legislation for this year which was not acted on. Localities have been delegated full planning and zoning authority.

South Dakota—A bill (H.R. 706) to designate and regulate critical areas was defeated in the House this year, 29–40. A bill (H.B. 762) requiring counties to develop comprehensive plans was passed. Another bill (H.B. 667) to continue a legislative land use committee to recommend legislation was passed. The state has a permit system for strip mining and enacted this year a use-value assessment for agricultural lands.

Tennessee—A bill to create a Tennessee Land Use Study Commission did not make it to the floor this year. It will probably be reintroduced next year. The state has a strong strip mining law; TVA handles most power plants; and localities have full zoning and planning authority.

Texas—A major report on Texas land use commissioned by the governor's office was released in December 1973. Three legislative committees are assessing land use and are expected to recommend legislation in 1975. The state has some regulatory powers over coastal activities. Texas has use-value assessment with deferred taxes on agricultural land. Counties have little planning and zoning authority.

Utah—The Utah Land Use Act, providing for designation of and planning for critical environmental areas, was passed by the legislature this year. A petition has held it up and voters will have to approve it in a November referendum. The Greenbelt Act permits preferential agricultural land taxation with a deferred tax. Localities have zoning and planning authority, but the zoning ordinances are superficial.

Vermont—In a major shift in the state's approach to land use planning, the 1974 legislature rejected the third phase in the development of a comprehensive land use plan for the state, a mapping program which would have divided the state into five categories (urban, village, natural resources, conservation, and rural) with different use and settlement goals. A legislative study committee is, instead, investigating the possibility of regulating critical areas and developments of more than local impact. The first two phases of the state land use plan culminated in the Land Capability and Development Plan, a guide for regulating development according to present land use and capability for development.

Virginia—The General Assembly adopted a resolution this year opposing a Federal land use act, declaring that land use planning is a state function. The legislature killed all pending state land use legislation. The Advisory Legislative Council's Land Use Policies Committee is reporting this year; and the state is undertaking a coastal zone management program under a Federal CZM grant.

Washington—Two different land use proposals were killed in the 1974 legislature before reaching the floor of either house, but at least one committee is holding interim sessions to prepare legislation for next year. The 1972 Shoreline Management Act provides for land use regulation of a large part of the state, including the shoreline, marshes, bogs, swamps, floodways, river deltas, and floodplains. All 39 counties have undertaken some kind of planning effort, and an estimated 25 counties have adopted zoning ordinances.

West Virginia—The state Planning and Development Department is limited to providing advice and technical assistance to local governments. Only 6 of 55 counties have adopted zoning ordinances. Eleven regional councils created in 1972 are making inventories and analyses of state resources.

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Wisconsin—In a referendum in April, voters approved preferential assessment and taxation of agricultural and open space lands. Implementing legislation is expected to be the main land use issue in the 1975 legislature. Proposals were killed this year for designation and regulation of critical environmental areas and developments of regional impact, acceleration of land use information gathering, protection of wetlands, and power plant siting. Under state guidelines and review, the Great Lakes shorelands are zoned into conservancy, recreational-residential, or general purpose areas.

Wyoming—The Conservation and Land Use Study Commission has drafted a state land use planning act for legislative consideration in 1975. Revenue from the Mineral Severance Tax enacted this year will be used to finance planning for boom-town growth expected to occur as strip mining operations increase.

CHAPTER 2

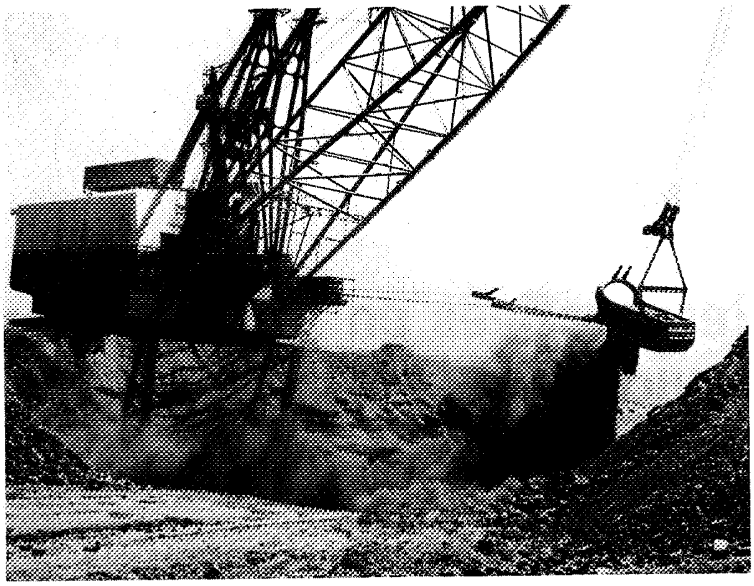
Perspectives on the Environment

The major event affecting the pursuit of environmental quality over the past year was the energy crisis. Emerging energy problems had been recognized for several years—President Nixon submitted his first message on energy policies to the Congress in 1971—but the Arab embargo in October transformed the problem into a crisis and created a new national outlook.

The crisis forced an abrupt public recognition that old patterns of energy supply (based on domestic oil and gas) were no longer providing for the Nation's needs and that alternatives to dependence on imported oil must be developed. As a result, the crisis centered attention on potential domestic sources of energy, such as offshore oil and gas, oil shale, and coal, and gave new urgency to conservation of energy as an essential requirement in moving towards national self-sufficiency.

The energy crisis also underlined the close relationship between the provision and consumption of energy and the protection of the environment. On the one hand, all options for expanding domestic energy production promise to have significant national and regional environmental implications. CEQ's study of the relative environmental risks of oil and gas development in the Atlantic and Gulf of Alaska outer continental shelves, delivered to the President in April 1974, is representative of the environmental assessments which will be required. On the other hand, the energy crisis created a new viewpoint on a wide range of traditional environmental concerns, including the pursuit of clean air, the disposal of solid waste, the conservation of resources, and the use and protection of the land.

The purpose of this chapter is to describe the major environmental events of the past year and place them in perspective. The importance



The major event affecting the pursuit of environmental quality over the past year was the energy crisis.

of the energy crisis makes it the appropriate starting point. Subsequent sections discuss the control of pollution—air, water, noise, and the disposition of solid wastes and hazardous substances—and the costs of controls. The final section discusses the protection of our natural heritage—wildlife, parks, wilderness, and forestland. The National Environmental Policy Act, land use, and international environmental events are treated in separate chapters.

Energy

In the field of energy, the events of the past year were many and complex, as are the issues for the future. Hence this discussion begins with a chronology. The succeeding sections discuss energy demand (in particular the role of energy conservation during the Arab embargo and in the future) and energy resource development: oil and gas, nuclear energy, advanced energy sources such as solar and geothermal energy, and coal. Of necessity, the discussion crisscrosses over the same ground from several points of view.

Energy: A Chronology

Energy problems became a matter of national urgency in 1973, but shortages of energy did not arrive overnight. In several preceding

winters, natural gas supplies had been interrupted with an increasing frequency in the northern and eastern United States; natural gas deliveries fell short of estimated demand by 3.7 percent in 1971 and 5.0 percent in 1972.[1] Shortages of petroleum distillates in the winter of 1972–73 forced the closing of schools and public buildings in Denver and other areas remote from the coastal refineries that process the rising flow of imported oil. Independent marketers of gasoline and distillates also began to feel the pinch.[2]

In 1973, it became evident that the Organization of Petroleum Exporting Countries (OPEC) had become a powerful force in the world oil market. Since the Teheran Agreement of 1971, American oil companies operating abroad had been forced to yield an increasing degree of operating control to foreign governments and to pay more taxes and royalties for oil. Imposition of production ceilings in some countries, coupled with rising world demand, resulted in a tight market situation in which companies with assured supplies of crude oil acquired considerable advantage over those without such supplies. Shortages among U.S. independent refiners and marketers led the Congress to add an amendment to the Economic Stabilization Act of 1973 giving the President authority to allocate scarce fuels.[3] The oil import quota system was abolished by the President in April 1973 and replaced with a license-fee system designed to encourage construction of refineries in the United States.[4]

By May 1973, the Office of Emergency Preparedness was reporting widespread closings of gasoline stations due to lack of fuel. Voluntary guidelines were announced on May 10 to assure that the burden of fuel shortages would be evenly shared by all parts of the oil industry and the country. Suppliers were asked to give their customers the same percentages of crude oil and refined products as they were given in the last quarter of 1971 and the first three quarters of 1972.

In June, the President transmitted a major energy message to the Congress (see Appendix F). In it, he announced the immediate establishment of a central Energy Policy Office in the White House to formulate and coordinate energy policies at the highest levels of government. For the longer term, the President reiterated his earlier proposal to the Congress for the establishment of a Department of Energy and Natural Resources (DENR) to consolidate the Federal Government's resources management functions, and also proposed that a separate Energy Research and Development Administration (ERDA) be established. The objective of ERDA would be to develop and demonstrate new technology to improve energy conservation and to make domestic energy resources—coal, nuclear, oil shale, solar, and geothermal—economically attractive and environmentally acceptable. ERDA would include the energy research and development capabilities of the Atomic Energy Commission, the Department of the Interior, and several other Federal agencies. The regulatory duties of the AEC were to be reconstituted in a separate Nuclear Energy Commission (NEC).

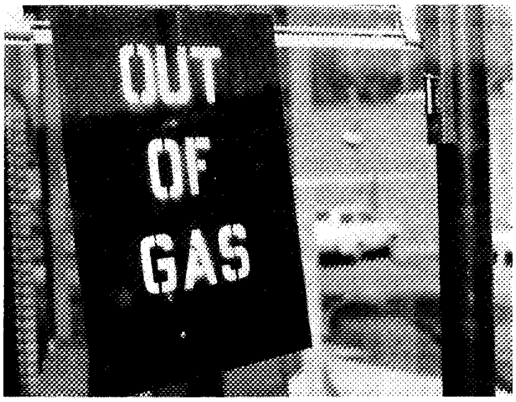
In the same message, the President pledged $10 billion for an expanded energy research and development effort to be spent over the next 5 years. He directed the Atomic Energy Commission to examine available R&D opportunities and develop a plan for exploiting them by December.

In August, the Cost of Living Council, which had been monitoring fuel prices for 2 years, began to focus on reported black market activities such as reduction of gasoline octane ratings without price cuts. In September, studies forecast serious deficits of distillate fuels by midwinter, with shortages to fall most heavily in New England and the Upper Midwest.[5] The Energy Policy Office announced that contingency plans for rationing heating oil were being readied. On September 8, the President asked that states modify clean air standards as an emergency measure to permit the use of high-sulfur oils from Caribbean refineries. The President also requested that the Congress approve increased crude oil production from Naval Petroleum Reserve No. 1 at Elk Hills, California, in order to boost rapidly deteriorating crude oil supplies.[6]

By the end of Sepember, it was clear that the combination of voluntary guidelines, price controls and incentives, and clean air variances could not avert distortions in the oil distribution system and serious fuel shortages in some parts of the country. On October 2, the first mandatory regulations, for propane gas, were published by the Energy Policy Office.[7] These were followed quickly by a program for the middle distillates—heating oil, kerosene, and diesel and jet fuel.

Tension in the Middle East built through the fall, and in October war broke out between Israel and the Arab states of Egypt and Syria. This conflict suddenly politicized U.S. imports of crude oil from the Persian Gulf and North Africa. Demanding withdrawal of U.S. military support for Israel, the Arab states agreed to cut off shipments to the United States and to reduce their monthly oil production by fixed percentages, thereby tightening supplies to European allies, an indirect means of forcing a change in U.S. Mideast policy. World oil prices rocketed, in some places to ten times the level of a year before.

On November 7, the President asked Congress for additional powers to meet the crisis and declared a "Project Independence" to move the Nation towards self-sufficiency in energy by 1980.[8] In mid-November, Congress passed legislation requiring a mandatory allocation program designed to preserve competition and assure equitable distribution of crude oil and petroleum products in critically short supply; it was signed by the President November 27.[9] The Office of Management and Budget was directed to lead an interagency task force to monitor allocation and to develop contingency plans for gasoline rationing, and tax or price incentive plans. A cabinet-level Emergency Energy Action Group was formed to make policy decisions. Throughout November and early December, the Administration considered various rationing and gasoline tax proposals intended



Such signs were common at service stations during the Arab embargo.

to cut supplies to motorists and thereby minimize the effects of fuel shortages on production and employment.

On December 4, the President asked the Congress to establish a Federal Energy Administration (FEA) to cope with shortages for a 2-year period while long-term reorganization proposals were being considered. The FEA was to be responsible for allocation programs, pricing policy, energy resource development, energy conservation, and overall energy planning. To deal with the immediate crisis, the President established a new Federal Energy Office (FEO) on an interim basis and gave it responsibility for directing the allocation program. On December 12, FEO published regulations for the distribution of crude oil and virtually all of its refined products.[10] On December 27, FEO announced the details of a gasoline rationing plan but promised that it would not be put into effect before March. By the end of December, however, estimates of the potential shortage in the first quarter of 1974 had fallen from 3.4 million barrels of oil per day to 2.7 million barrels per day.[11] New allocation plans were developed and put into effect January 15.

During the summer and fall, the AEC worked on the $10 billion research and development plan requested by the President in June. With the assistance of the Energy Research and Development Advisory Council appointed by the President in October 1973, the R&D program was developed and a report sent to the White House in December.[12] Heavy Federal funding was recommended for the liquid metal fast breeder reactor (LMFBR) program and for the development of nuclear fusion through confinement technology. A dramatic increase in funding was also suggested for support of coal mining and utilization technology, particularly high-BTU gasification and liquefaction. In order to accelerate development of a coal-based synthetic fuels industry, the report recommended a synthetic fuels program with construction of first-generation plants to begin immediately. The report also recommended sharp increases for research in solar and

geothermal energy and a $1 billion supplement for basic energy research, manpower development, and research on the environmental effects of energy development. The objective of the environment effects effort, for which $650 million was recommended, was "to establish the capability to determine and control effectively the environmental and health insults from the energy system through development of a sound technical and scientific basis for ensuring protection of the total ecosystem." [13]

In his February budget message, the President sent the Congress a request retaining the chief emphasis of the AEC report.[14] The components of the request are presented in Table 1.

Throughout the winter, an expanded FEO staff monitored the allocation system through 10 regional offices across the country. Refiners were ordered February 14 to increase production of diesel and jet fuels and to furnish additional fuel to truck stops.[15] Gasoline price increases were approved to discourage consumption and to protect retailers threatened by falling volume of sales. On February 19, FEO ordered that emergency gasoline allocations be given to the 20 states hardest hit by shortages.[16]

During the winter, conservation programs, warm weather, and reported leakage in the Arab oil embargo helped to keep the gap between supply and demand at a manageable level, although many motorists suffered inconvenience, and utilities and large factories were forced to trim their fuel consumption.

The Congress failed to reach agreement on emergency energy legislation before the Christmas recess. On February 27, a bill authorizing

Table 1

Federal Energy Research and Development Program, Proposed FY 1975 Budget

[In millions of dollars]

Program area	Program level (obligations)			Estimated total FY 1975–79
	FY 1973	FY 1974	FY 1975	
Conservation	**32.2**	**65.0**	**115.7**	**700**
End use (residential and commercial)	—	15.0	15.0	
Improved efficiency (transmission)	2.9	5.0	18.8	
Improved efficiency (conversion)	6.5	14.9	29.8	
Improved efficiency (storage)	1.6	2.9	6.4	
Automotive	7.4	14.2	23.7	
Other transportation	13.8	13.0	22.0	
Oil, gas, and shale	**18.7**	**19.1**	**41.8**	**400**
Production	.3	3.0	17.0	
Resource assessment	4.5	5.0	13.1	
Oil shale	3.2	2.3	3.0	
Related programs	10.7	8.8	8.7	

See footnotes at end of table.

Table 1—Continued

Program area	(Program level obligations) FY 1973	FY 1974	FY 1975	Estimated total FY 1975–79
Coal	**85.1**	**164.4**	**426.7**	**2,900**
Mining	1.7	7.5	55.0	
Mining health and safety	28.2	28.3	31.0	
Direct combustion	1.5	15.9	36.2	
Liquefaction	11.0	45.5	108.5	
Gasification (high BTU)[1]	32.5	33.0	65.3	
Gasification (low BTU)	4.6	21.3	50.7	
Synthetic fuels pioneer program	—	—	50.0	
Resource assessment	1.0	1.2	1.9	
Other (including common technology)	4.6	11.7	28.1	
Environmental control	**38.4**	**65.5**	**178.5**	**800**
Near-term SO_x	19.0	39.9	82.0	
Advanced SO_x	—	4.0	12.0	
Other fossil fuel pollutants (including NO_x, particulates)	8.8	13.1	57.0	
Thermal pollution	.6	1.5	18.5	
Automotive emissions	10.0	7.0	9.0	
Nuclear fission	**406.5**	**530.5**	**724.7**	**4,000**
LMFBR	253.7	357.3	473.4	
Other breeders (GCFBR and MSBR)	5.6	4.0	11.0	
HTGR	7.3	13.8	41.0	
LWBR	29.5	29.0	21.4	
Reactor safety research	38.8	48.6	61.2	
Waste management	3.6	6.2	11.5	
Uranium enrichment	50.3	57.5	66.0	
Resource assessment	2.8	3.4	10.4	
Other (including advanced technology)	14.9	10.7	28.8	
Nuclear fusion	**74.8**	**101.1**	**168.6**	**1,600**
CTR	39.7	57.0	102.3	
Laser[2]	35.1	44.1	66.3	
Other	**16.5**	**53.5**	**154.5**	**900**
Solar	4.0	13.8	50.0	
Geothermal	4.4	10.9	44.7	
Systems studies	7.2	17.3	30.0	
Miscellaneous	.9	11.5	29.8	
Total, direct energy	**672.2**	**999.1**	**1,810.5**	**11,300**
Additional funds for support programs				
Environmental and health effects research			+133.7	
Basic research and manpower development			+82.3	
Total			**+216.0**	

[1] Funds for high BTU gasification in Office of Coal Research budget do not include Trust Fund amounts.
[2] Includes funds for laser fusion with military applications.

Source: Fact sheet to accompany the President's Energy Message, issued by office of the White House Press Secretary, January 23, 1974.

gasoline rationing and other conservation measures was cleared for the President's signature. Because the bill provided for a rollback of crude oil prices, a measure opposed by the Administration as likely to worsen the shortages, the President vetoed it in March.[17]

On March 18, the emergency period came to an end when seven Arab oil-producing countries agreed to lift the embargo against the United States. Imported oil began to flow into the United States once again. By summer, domestic inventories had been restored.

In May, legislation to establish the Federal Energy Administration was passed by the Congress and approved by the President.[18] The FEA accelerated its work to develop the Project Independence blueprint, a comprehensive plan for energy resource development to 1985. At the same time, the proposal to create ERDA was well received by the Congress, and establishment of this new agency and the Nuclear Energy Commission is expected late this year.

Energy Conservation

Energy conservation, which had been of interest primarily to environmentalists and certain energy-intensive industries in the past, emerged this year as a matter of major national importance. Conservation played a vital role in helping the Nation adjust to the Arab oil boycott. And for the longer run, energy conservation has become a central element in the national effort to move toward energy self-sufficiency.

Energy conservation (or demand reduction) occurs for one of two reasons. First, increases in the price of energy tend to reduce the quantity demanded. An example is a homeowner's decision to turn down the thermostat to reduce his monthly fuel bill. Second, changes in habits, tastes, or government regulation can also serve to reduce demand. Here the imposition through legislation of an energy-saving 55 mph speed limit is a good illustration. In practice, it is extremely difficult to assign reduced consumption specifically to one or another of these phenomena, and the conservation of energy achieved over the past year reflected both.

The Past Year

The historically unprecedented rise in the cost of fuel during the past year was a major stimulant to conservation. Gasoline retailing for 35¢ per gallon in September 1973 rose to 55¢ per gallon by June 1974, and prices of over $1 per gallon, although illegal, occasionally occurred during the severe shortage months of January and February 1974. Distillate heating oil rose from around 18¢ to around 30¢ per gallon during the October 1973–April 1974 period, and the price of diesel fuel, propane, coal, and other primary fuels also rose. Elec-

tricity prices also skyrocketed, first as the price of primary fuels rose and second as consumption fell off, leaving overhead charges to be absorbed by a smaller sales base. For example, the average cost per kilowatt-hour to typical residential users in New York City rose from 4.5¢ to 6.4¢ from February 1973 to February 1974.[19]

In the case of gasoline, the posted pump price did not reflect the full cost of the shortage to the consumer. Limits on the amount which could be purchased and curtailments in service station operating hours forced motorists to spend time in queues or simply exploring to find open stations. Although the adoption of practices such as odd-and-even-day sales helped mitigate a chaotic situation, the cost in time to consumers amounted to a considerable surcharge per gallon.

Even before these price increases took effect, Federal and state governments had undertaken initiatives designed to lower energy demand. In June 1973, the President set an energy reduction goal of 7 percent for the Federal Government during fiscal year 1974 and asked the Nation as a whole to save at least 5 percent of anticipated energy consumption for the same period.[20] In his message to the Nation on November 7, 1973, the President asked all states to adopt and enforce lower highway speed limits.[21] In December 1973, legislation was passed requiring all states to convert from standard to daylight savings time.[22] Although savings were not expected to be substantial, the objective was to use the natural light during the evening hours to diminish energy requirements for heat and light and lessen the load on less efficient peak-load electricity generating facilities.

To aid consumers in making intelligent purchases, the Administration proposed legislation requiring many home appliances and all automobiles to bear labels describing their energy use characteristics.[23] This initiative was an extension of voluntary labeling programs ordered the previous year by the President and undertaken by the National Bureau of Standards of the Department of Commerce and by the Environmental Protection Agency. Room air conditioners are now being labeled under the NBS voluntary program, and autos were labeled under the EPA program beginning in the fall of 1973. FHA home insulation standards were also reexamined in the light of energy market developments, and more effective standards are being readied.

In addition to these specific actions, the Administration appealed to both consumers and business to practice conservation and undertook an internal program to show that energy conservation was both practical and effective. Government buildings were "delamped" to reduce excessive lighting levels, and thermostats were turned down. Car pools were encouraged through parking restrictions, and all travel requests were audited more tightly to determine their necessity. Overall, it has been calculated that this effort cut Federal fuel consumption by about 26 percent from June 1973 to March 1974, equal to a savings of 75 million barrels of oil.[24]

Industry also responded successfully to the challenge of higher energy prices, fuel shortages, and government exhortation and exam-

Improved insulation of homes and other buildings offers great opportunity for saving energy.

ple. A comparison of the 4 months ending January 31, 1974, with the same period a year earlier showed that industrial energy consumption fell by about 0.1 percent at the same time that industrial output rose by 5 percent.[25] This represents a reduction in energy consumption per unit of output (or an increase in energy efficiency) of slightly less than 5 percent.

Several large corporations have reported impressive results from energy conservation efforts. Dow Chemical U.S.A., for instance, achieved a 10 percent reduction in energy consumed per unit of output in 1972 and again in 1973; its target for 1974 is a further 7 percent reduction per unit of output.[26] J.C. Penney cut energy consumption more than 26 percent. By adjusting thermostats to recommended levels, by demonstrating fewer television sets, and by reducing lighting levels, this corporation in 1974 is saving the equivalent of 3,700 barrels of oil per day without cutting store hours or operating efficiency.[27]

In the residential sector, heating oil consumption was down nationally by about 14 percent. Of this reduction, 5 or 6 percent was due to unseasonally warm weather, with the remainder—8 or 9 percent—due to conservation. Residential natural gas consumption was down by about 9 percent during the winter, even though utilities were serving greater numbers of customers. Households also cut electricity use by 3 to 6 percent, varying by region. These cutbacks were due to both higher prices and a willingness of the public to cooperate during a national emergency.[28]

As would be expected, the most drastic change in energy consumption occurred in the transportation sector. During the first quarter of 1974, total gasoline consumption averaged 8 to 10 percent below that of the year before.[29] Shifts to car pools and mass transit for commuting to work were major factors in helping the Nation adjust

Table 2

Changes in Class of New Car Sales, March 1973–March 1974

Auto class	Percent change in market penetration
Low specialty	62.4
Compact	28.5
Subcompact	6.5
Luxury	−1.6
Intermediate	−1.3
Standard	−20.6
High specialty	−22.5
Medium	−31.7

Source: Energy and Environmental Analysis, Inc.

to the energy shortage. However, the major reduction in gasoline consumption was for discretionary trips for leisure and recreation, which fell drastically, as shown in occupancy rates at hotels and motels outside metropolitan areas, which dropped by as much as 65 percent below the previous winter.

The institution and enforcement of a 55 mph speed limit on all interstate highways saved both lives and energy. Most automobiles get over 20 percent more miles per gallon at 55 mph than at 70 mph. Lower speed limits probably accounted for a 1 to 2 percent reduction in total gasoline consumption. At the same time, U.S. traffic fatalities dropped 24 percent in the first 4 months of 1974, compared to a year earlier.[30]

One of the most dramatic effects of the gasoline shortage and higher prices was on new car sales. Consumer preferences shifted sharply toward smaller, more efficient cars, as shown in Table 2. Although this trend has been in evidence for several years, the rapidity and the magnitude of the shift caught most of the major American automobile producers unprepared. If the trend continues, broader usage of smaller cars with better fuel economy can significantly reduce our Nation's demand for gasoline in the future.

Even with the restoration of gasoline supplies, energy conservation practices continued to be evident during the summer of 1974. If gasoline prices had remained at 1973 levels and if incomes had risen at a normal pace, gasoline consumption in the summer of 1974 would have been 3 to 4 percent above the previous summer. It appears, however, that actual consumption will be about 0.5 percent lower. Thus a combination of higher prices and slower growth in real income has led consumers to reduce their gasoline consumption by 3.5 to 4.5 percent.[31]

Perspective on the Future

As the Nation struggled with emergency energy conservation issues, a new perspective emerged with respect to long-term energy conservation. At the crux of the problem was a crucial issue: Could the United States retain a high employment economic growth rate while substantially lowering its growth rate of energy consumption? The controversy over the relationship between economic growth and energy growth was based on the observation that in the past the two had shown a close long-run correlation.

Prior to the Arab embargo, most energy consumption forecasts assumed a continuation of the nearly constant relationship with GNP. Demand for almost all fuels was regarded to be on the whole insensitive to changes in price. Perhaps the most widely quoted projection was that published by the Department of the Interior in December 1972.[32] This detailed forecast showed total energy consumption nearly tripling between 1970 and 2000.

The energy shortage of the past winter, however, prompted a reexamination of this relationship. Several econometric studies by prominent economists found that energy consumption was considerably more price-sensitive than had previously been thought. Others began to doubt the necessity of high energy growth. For example, Jorgenson and Hudson of Harvard and Data Resources, Inc., developed a sophisticated model to simulate the U.S. economy under different conditions of energy supply and demand and concluded that substantial energy conservation is possible within the existing structure of the economy. While reduced energy use would have some small effects on the GNP (a reduction of 3.5 percent in the year 2000) and cause a marginal increase in inflation, it would not jeopardize economic growth and would have positive effects on employment.[33] In short, energy forecasters moved toward a new perspective in which energy was seen as a factor of production as susceptible to substitution as capital and labor.

A number of new long-range energy projections began to appear, differing radically from those of just a year earlier. Both the Ford Foundation's Energy Policy Project [34] and the Council on Environmental Quality published projections incorporating energy conservation efforts which resulted in total energy requirements one-third lower than the year 2000 projections published earlier.

CEQ's Half and Half Plan [35] called for a serious long-term national program to conserve energy while at the same time meeting the needs of a growing economy. It suggested a target for the year 2000 based on growth in net per capita energy consumption of 0.7 percent per year and on a continuing conservation effort which, through improved efficiency and elimination of waste, would save energy at a rate of 0.7 percent per year. Such a program—half growth and half conservation—would provide an effective increase in usable energy of 1.4 percent per year, equal to the average rate of growth experi-

enced during the 1947–72 period of generally rapid economic growth. The Half and Half Plan is described in more detail in Chapter 6.

This debate is by no means concluded, but a rigid linkage between energy growth and economic growth is no longer accepted as self-evident, and the importance of energy demand management in future energy planning is now broadly recognized.

Energy conservation is particularly attractive from an environmental viewpoint. In general, the lower the level of energy production and consumption activities, the lower the level of environmental degradation. For example, it is quite conceivable that by the early 1980's new automobiles could average 20 miles per gallon. If they did, the Nation could realize energy savings of 2 quadrillion BTUs in 1985. This reduction in gasoline demand represents four large oil refineries and numerous oil wells, pipelines, and tankers. In short, to the extent that economic and social goals can be achieved with lower levels of energy use, the environment will benefit.

Energy Resource Development

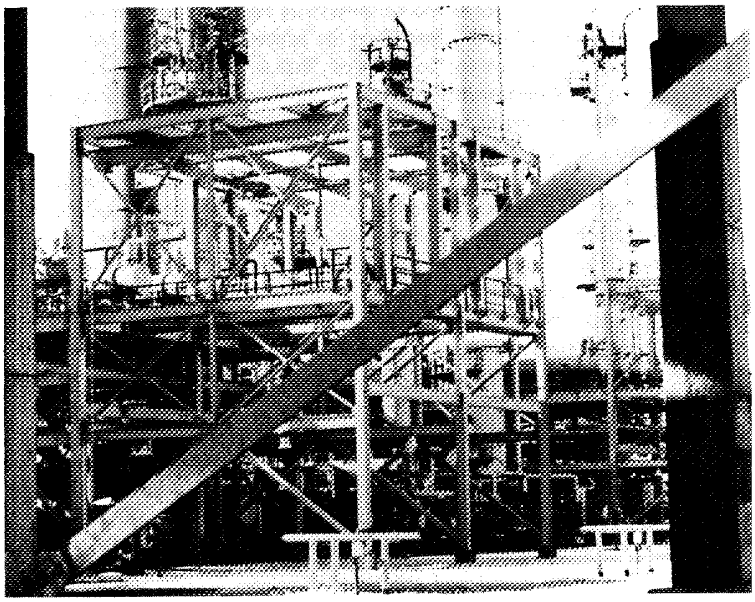
With the initiation of Project Independence, attention was directed to domestic energy resources and the need to protect the environment as production is expanded.

Oil and Gas

The United States is heavily dependent on oil and gas to meet its energy needs. In 1972, oil and gas accounted for nearly 78 percent of U.S. energy consumption. The percentage of national energy demand met by these two sources had risen markedly in the 1950's, from 58 percent in 1950 to 74 percent in 1960. Beginning in the late 1960's, increasing quantities of crude oil and refined petroleum products were imported to supplement stagnating domestic production and diminished exploratory drilling. Immediately prior to the Arab embargo, imports had risen to nearly 6 million barrels of oil per day, or over 30 percent of total petroleum consumption. Some forecasts made before the embargo foresaw oil imports rising to 15 to 20 million barrels per day by 1985 and 25 to 35 million barrels per day by 2000.[36] The past year brought the realization that the United States could not allow such high levels of oil imports for both security and economic reasons.

Domestic production of petroleum liquids reached a peak in 1970, and it remains to be seen whether increased exploration (in response to higher prices) will lead to substantially increased supplies of new oil. Some geologists believe that U.S. oil production levels will not significantly increase above today's level.

Domestic natural gas production, although still growing, has failed



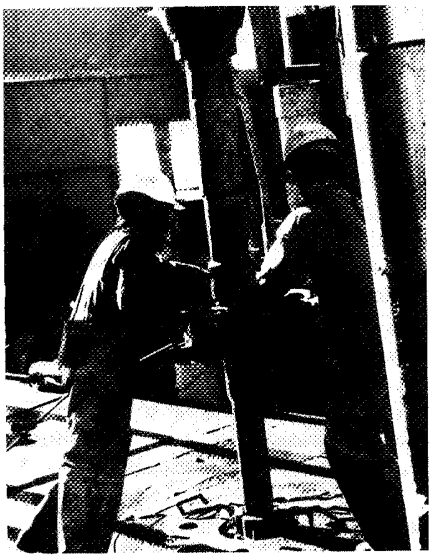
In 1972, oil and gas accounted for nearly 78 percent of U.S. energy consumption.

to keep pace with demand. Further, additions to gas reserves have been much less than production levels during the past few years. The response of natural gas supply to increased oil and gas prices also remains to be seen.

Several important steps were taken during the past year to increase U.S. oil and gas supplies: Federal legislation authorizing construction of the Trans-Alaska pipeline was enacted; [37] the leasing program for the outer continental shelf was expanded; and administration proposals to authorize construction of deepwater ports and revise regulatory procedures for natural gas sales were under consideration by the Congress.[38]

Alaskan Pipeline—In 1970, a court decision required the Secretary of the Interior to prepare an environmental impact statement under NEPA before issuing permits for construction of an oil pipeline from Alaskan oil fields on the North Slope to the ice-free port of Valdez.[39] Following issuance of the environmental impact statement in 1972, the project was approved, but the District of Columbia Court of Appeals then found that the pipeline construction would require a right-of-way in excess of the 50-foot width permitted in the Mineral Leasing Act of 1920.[40] In April 1973, the Supreme Court declined to review the Court of Appeals decision.[41]

In November 1973, the Congress passed and the President signed legislation specifically directing the Secretary of the Interior to au-



Drilling operations offshore on the Gulf of Mexico.

thorize construction of the Alaskan pipeline. Construction permits were issued in January, and work on the pipeline began. By 1980, it is expected that 2 million barrels of oil per day will flow from the North Slope to tanker terminals at Valdez.

OCS Leasing—Between 1954 and 1973, the Interior Department leased almost 8 million acres on the outer continental shelf for oil and gas development. In April 1973, the President promised to triple the amount of Federal OCS lands leased annually for oil and gas development from 1 million acres in 1973 to 3 million acres in 1979.[42] A higher goal of 10 million acres for 1975 was announced in the President's energy message of January 1974 (see Appendix F). In line with the accelerated program, several large lease sales were held during the year. In December 1973, the Bureau of Land Management received high bids totaling $1.49 billion for 39 tracts in the northeast Gulf of Mexico. This record was surpassed by the first 1974 sale in which high bids of $2.16 billion were submitted.[43]

In March 1974, on the basis of more recent and complete geophysical data, the U.S. Geological Survey issued revised estimates of offshore oil and gas potential.[44] Reserves were estimated at 10 to 13 billion barrels of oil and 71 to 93 trillion cubic feet of gas. Undiscovered recoverable resources were estimated at 65 to 130 billion barrels of oil and 395 to 790 trillion cubic feet of gas. The new figures were lower than the previous estimate of 200 billion barrels of oil and 850 trillion cubic feet of gas.

In April 1974, CEQ completed its 1-year assessment of the potential environmental impact of OCS oil and gas development in two virgin OCS areas—the Atlantic and the Gulf of Alaska. CEQ had

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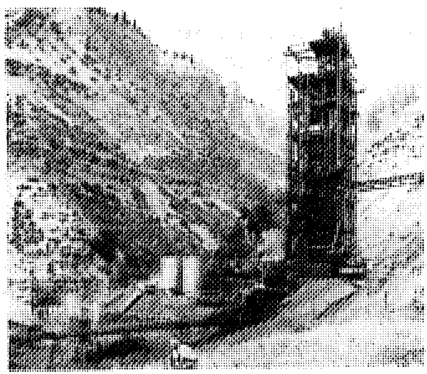
been directed to undertake this study by the President in his Energy Message of April 1973. The study ranked the various OCS regions as to relative environmental risks from offshore oil and gas development and recommended measures to reduce the risks to acceptable levels. The results of the study are described in Chapter 6.

Deepwater Ports—The OCS is also expected to be the site of deepwater ports for the very large crude carriers (VLCC's) now in use in the world oil trade. These tankers, displacing 200,000 or more deadweight tons, are too large for U.S. harbor facilities. As described in last year's Annual Report, deepwater ports offer potential environmental benefits. In 1973, the President first proposed legislation to authorize their construction. In his January 1974 Energy Message, he reiterated this request, emphasizing that despite the effort to achieve self-sufficiency, the United States will continue to import oil as long as it is available at reasonable prices.[45] In June, the House passed a bill establishing a licensing system for deepwater ports.[46]

Natural Gas Deregulation—To spur domestic production of natural gas and to encourage conservation of this valuable fuel, in April 1973 the President proposed legislation to phase out Federal Power Commission control over the wellhead price of natural gas newly dedicated to the interstate market and of flowing gas on which contracts had expired.[47] Extensive hearings on deregulation were held between October 1973 and April 1974 in the Senate, but as of August no bill had been reported. In administrative actions designed to reduce the downtrend in gas reserves, the FPC has taken steps to increase wellhead prices and offer other incentives to encourage exploration and development. However, these higher rates apply to only a small fraction of total gas supplies.[48]

Oil Shale—The steep rise in oil prices in 1973 has made the relatively expensive technology for recovering oil from shale more economically attractive, but critical environmental problems require



Higher energy prices have made oil from shale more attractive, but difficult environmental problems remain to be solved.

solution before a full-fledged industry can be developed. One purpose of the Department of the Interior's prototype oil shale leasing program is to seek ways to mitigate environmental impacts. Generally, two methods of extracting oil from shale are being researched: conventional surface or underground mining followed by surface processing of the shale; and underground (*in situ*) processing. The Federal Government has provided some support for both processes.

Of the technical obstacles which may prevent truly large-scale development of oil shale resources, the availability of water and the disposal of spent shale are considered particularly difficult. One study indicates that although water to support a 1 million barrel per day industry may be available, a 3-to-5 million barrel per day industry using current technology might require all the surface water in the oil shale regions of Colorado, Utah, and Wyoming. Further, a 1 million barrel per day industry using current technology would require disposal of 1.5 million tons of waste materials per day.[49]

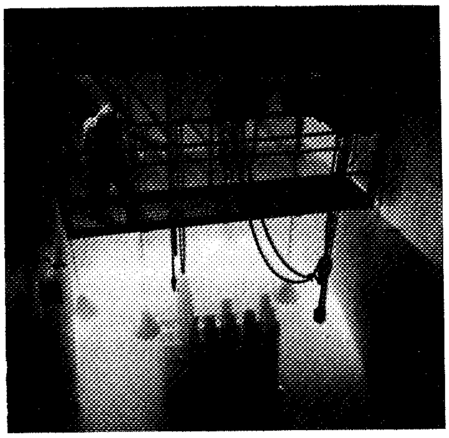
The final environmental impact statement for the Interior Department's prototype Oil Shale Leasing Program was filed in August 1973.[50] Six tracts were designated for leasing, two each in Colorado, Utah, and Wyoming. In January 1974, a 5,089-acre tract in Colorado was leased for a record-setting bid of $210 million. A second Colorado tract was leased for $118 million, and Utah tracts drew bids of $76 million and $45 million.[51] Two tracts located in Wyoming, which were to have been developed by *in situ* methods, drew no bids, indicating a need for further research on this approach.

Nuclear Energy

Nuclear power continued to expand rapidly in the past year. Nine new nuclear units began operation in 1973, increasing nuclear electrical generating capacity to over 20,000 megawatts, or over 5 percent of the Nation's total electric capacity.[52] For the decade ahead, over 150 additional nuclear units are under construction or planned, representing an additional 150,000 megawatts.

A number of nuclear units scheduled for completion during the past year were delayed for a variety of reasons: changes in reactor design, regulatory changes, late delivery of equipment, shortages of engineers and craft laborers, inadequate labor productivity, and others.[53] As much as 9 to 10 years has been required from initial application for a nuclear plant license to full-power operation. In his energy messages during the past year, President Nixon called for greater speed in licensing and constructing nuclear plants in order to reduce the time required to 5 to 6 years.

The AEC, which regulates nuclear power plants, is developing streamlined procedures for licensing such plants while retaining adequate safety and environmental review. In addition, the AEC has



Nuclear power now accounts for over 5 percent of U.S. electric capacity.

proposed draft legislation to accomplish certain significant changes. First, the nuclear industry would be offered incentives to construct standardized designs, thus permitting mass production of key components and a one-time evaluation of reactor safety, rather than continuing to build one-of-a-kind plants as in the past. Second, the AEC would identify potential sites for nuclear plants which could undergo the necessary environmental review so that the sites would be available and preapproved for use when a utility was ready to build. Third, an applicant would be able to choose from three procedures in getting AEC approval to build and operate a plant.[54]

The AEC's proposal to develop the Liquid Metal Fast Breeder Reactor (LMFBR) was subjected to an intensive environmental review during the past year. In June 1973, the District of Columbia Court of Appeals ordered the AEC to go beyond its environmental impact statement (EIS) on the proposed breeder demonstration plant to be built in Tennessee and to prepare a comprehensive EIS on the consequences of widespread use of LMFBR technology.[55] In March 1974, the AEC filed its draft EIS on the LMFBR program.[56]

Both in written comments and in testimony before an April hearing, a number of environmental groups objected to features of the AEC's statement. The Environmental Protection Agency called the draft statement inadequate.[57] The serious objections concerned LMFBR safety, radioactive waste disposal, threat of nuclear theft or sabotage, environmental health effects of plutonium, and biases in cost-benefit analysis of the program (some of these are discussed in more detail later in this chapter). AEC has received an extension on the original court-ordered deadline of June 14, 1974 to revise the EIS. After completion of the final statement, the Commission must make a determination of the probable ultimate environmental effects of the LMFBR and their effect on its further development.

Advanced Energy Sources

Increasing attention was focused on advanced forms of energy in the past year. Commercial use of geothermal steam moved ahead, and Federal R&D was expanded on more advanced forms of geothermal energy extraction. Federal support of both solar and fusion power R&D also increased significantly.

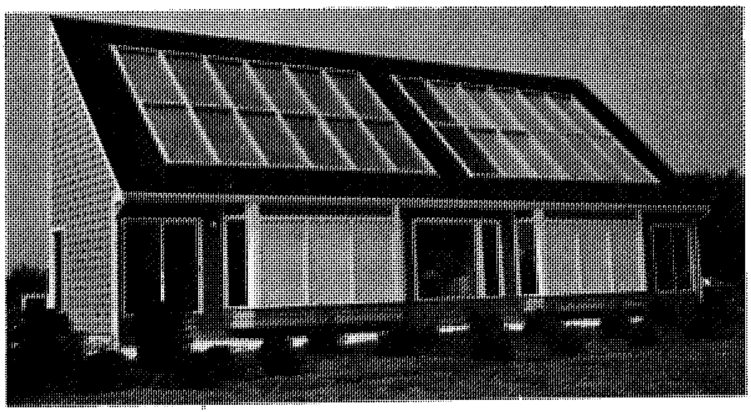
Geothermal Energy—Technology to tap some forms of the earth's heat is considered well in hand and is being applied at the Geysers site in northern California, where the Pacific Gas and Electric Company utilizes geothermal steam as a power source for a 400-megawatt electrical generating facility. Geothermal resources fall into three broadly defined categories—dry steam, hot steam, and hot water—but as yet only dry geothermal steam used to drive an electric turbine generator is considered economically inviting. However, hot dry rock sources are by far the most extensive. At the AEC's Los Alamos Scientific Laboratory, techniques for fracturing hot rock at deep levels are being investigated. It is hoped that some of the heat flowing outward from the earth's core may be captured by introducing water into a deep fissure and then drawing off hot water at the surface. Potential environmental problems associated with this technique have not yet been identified.

The Federal budget for R&D in geothermal energy has climbed from $4.4 million in 1973 to $10.9 million in 1974 to $44.7 million requested for 1975 (Table 1), a reflection of the promise felt to lie in energy from the earth's heat.[58]

Commercial use of geothermal steam was accelerated in the past year by leasing Federal lands under the Geothermal Steam Act of 1970.[59] The Department of the Interior completed its environmental assessment of the geothermal leasing program in October 1973 and held four lease sales of known geothermal areas underlying Federal lands in California and Oregon between January and June.

Solar Energy—Both the economic and technical viability of solar energy moved strongly ahead during the past year. The environmental benefits of capturing the sun's energy have been recognized for some time; with much higher prices of oil, the economic differential between solar heating and cooling systems and conventional fossil fuel systems was markedly reduced. Technological progress was enhanced through new developments supported by both the Federal Government and private industry.

Federal R&D funding for solar energy has increased from $4 million in 1973 to $13.8 million in 1974 (Table 1) and to $50 million requested in 1975.[60] During the coming year, the National Science Foundation's solar program will be moving from the program definition phase to vigorous funding of proof-of-concept projects, especially in solar space heating and cooling and hot water heating.



This experimental house was built to test a variety of solar energy techniques.

Fusion Energy—Although the feasibility of controlled thermonuclear fusion reactors remains to be fully determined, important progress toward that first critical milestone was made during the past year. Magnetic confinement fusion plasma experiments have continued to verify that physical scaling laws are valid under conditions approaching those required to demonstrate scientific feasibility and that methods such as neutral beam injection are probably suitable for heating the plasma to the ignition temperature. Several larger magnetic confinement fusion experimental facilities are under construction to further the advance toward demonstration. In other experiments during the past year, for the first time in the United States (and perhaps the world), laser-triggered fusion reactions were achieved with the production of very small numbers of high energy neutrons.

As shown in Table 1, Federal funding of fusion power research has increased from $74.8 million in 1973 to $101.1 million in 1974 to $168.6 million requested in 1975.[61]

Coal

In 1972, coal provided about 17 percent of U.S. energy needs. While the quantity of coal produced in the United States today is about the same as 25 years ago (about 600 million tons per year, of which 60 million tons is for export), the percentage of national energy supply met by coal dropped from 38 percent in 1950 to 22.6 percent in 1970. But coal is our most abundant fossil fuel. The Department of the Interior estimates that we have reserves of 200 to 250 billion tons and a resource base of over 3 trillion tons.[62] Success of Project Independence depends largely on the ability to use massive quantities of coal in place of imported oil. This may require expanding U.S.

coal production and use to 1.2 to 1.8 billion tons per year by 1985. To accomplish this, major problems—many of which are environmental—will have to be overcome.

A number of developments within the past year affected coal use and its impact on the environment. These will be examined by first considering those developments influencing coal use during the 1980's and beyond and then by concentrating on those affecting its expanded use at the present time.

Research and Development—The President's energy R&D program proposed that $3.5 billion be spent on coal programs over the next 5 years. The budget for FY 1975 proposed $426.7 million for coal research and development, an increase of $262 million or 160 percent over the previous year.[63] (See Table 1.) The objectives of the Federal coal R&D programs are twofold: to be able to mine increased quantities of coal at acceptable social, environmental, and economic costs, and to provide the technical capability for producing coal-derived fuels in whatever form or quantity needed by the market place.

To achieve the objective of acceptable mining techniques, significantly expanded programs in underground and surface mining R&D have been initiated by the Department of the Interior. Currently about half of the coal is produced by underground mining and half by surface mining, with surface mining growing rapidly. New techniques for underground mining may allow the safe and economical extraction of the Nation's vastly more abundant deep coal resources. New techniques for reclaiming and revegetating strip-mined lands may avert many of the environmental impacts of surface mining.

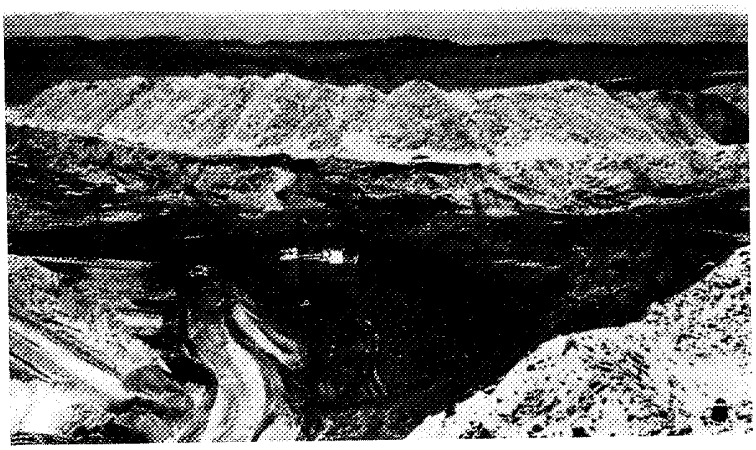
Development of processes to produce coal-derived synthetic fuels would result in an equally important environmental benefit—removal of the ash and much of the sulfur from the coal, resulting in significantly reduced air pollution from combustion. R&D programs on liquefaction and gasification of coal have been significantly expanded by the Interior Department within the past year. Gasification processes are being developed which would produce either a high-heat-content pipeline-quality substitute for natural gas or a low-heat synthetic fuel for utility boilers. Fuel processing and use are not without environmental problems, in particular emissions of air and water pollutants, and these problems must be solved during the R&D phase.

Two technologies for reducing air pollution from coal combustion are being improved for application in the nearer term. Advanced stack gas cleaning processes are being developed by EPA in order to improve performance and reduce the cost and waste disposal problems associated with current scrubbing systems. Direct combustion processes using fluidized bed boilers are being jointly developed by EPA and the Interior Department. These two technologies could find applications in the late 1970's, well before significant quantities of synthetic fuels become available.

Federal Coal Leasing—The Federal Government owns about 40 percent of U.S. coal reserves, primarily in the West. Low in sulfur content, these western coal reserves have become increasingly desirable due to the requirements of the Clean Air Act, the ease of their recovery by strip mining, and fewer labor difficulties. In May 1971, the Interior Department declared a moratorium on coal leasing until a long-range leasing policy could be developed and a programmatic environmental impact statement filed.[64] Aside from short-term leasing allowed in February 1973 to maintain existing operations and supply current markets, no new coal leases have been issued. In May 1974, the Interior Department issued a draft EIS on the coal leasing program. The Department stated that it planned to make a decision during 1974 on whether to begin issuing competitive coal leases in fiscal year 1975 in areas that have the most workable coal seams and the least risk of environmental damage.[65]

The EIS is part of a larger new effort within the Federal Government to develop a comprehensive long-range coal policy. In March 1974, an interagency coal task force, representing all Federal departments and agencies with coal-related responsibilities, was established to develop a coordinated Federal coal policy, including leasing policy. The Interior Department plans to issue an interim report on the Northern Great Plains Resource Program study. The report will describe the potential social, economic, and environmental impacts of development of the Northern Great Plains' vast strippable reserves of coal, of which the Federal Government owns about 80 percent.[66]

Opinion on expanding Federal coal leasing, however, is not uniform. Two independent studies released in spring 1974 maintain that there is no need to rush to award new coal leases. Both the Ford Foundation's Energy Policy Project [67] and the Council on Economic Priorities [68] said that less than 10 percent of existing coal leases are



Surface mining in the West, where the Federal Government owns about 80 percent of the reserves.

currently being mined and that, because the leasing laws have no mandatory production requirements, many leases have simply been held for speculation. In light of the large number of these undeveloped coal leases, the reports recommended reassessment of Interior's proposed leasing policy.

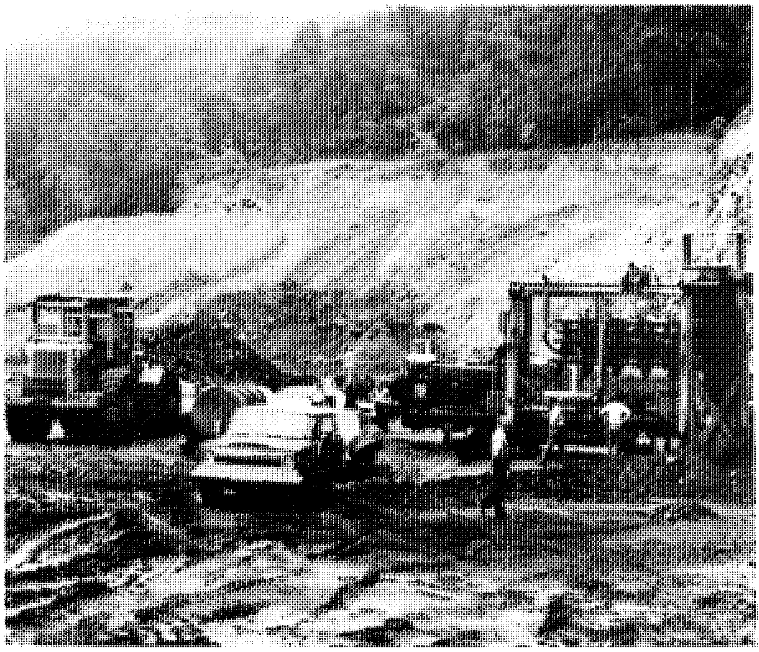
Surface Mining—The most visible environmental impact of coal production is strip-mined lands. Early in 1973, the President proposed the Mined Area Protection Act [69] to establish reclamation performance standards for both surface and underground mining. In October 1973, the Senate passed a bill which would place very stringent controls on coal strip mining.[70] This bill not only would require restoration of strip-mined land to its approximate original contour but would also preclude the mining of substantial amounts of Federal coal in the West. In July 1974, the House of Representatives also passed strip-mining legislation with reclamation provisions similar to those in the Senate bill.[71] In August, the Administration expressed satisfaction that legislation to control the abuses of strip mining had passed both Houses of Congress and the hope that a workable compromise, establishing strict environmental control without prohibitive coal production losses, could be developed by the conference committee.

Water shortages threaten to become the largest problem facing western surface mining. A May 1974 report of the National Academy of Sciences (NAS) warned that it is doubtful that some western lands can be rehabilitated if they are mined.[72] Because successful revegetation in areas where rainfall is less than 10 inches per year may be impossible without proper management and major sustained inputs of irrigation water and fertilizer, the study concluded that meeting the requirement of restoration of the land to its original condition will be far more difficult in the West than in the East. In addition, the NAS report concluded that the arid climate of the West may also block large-scale conversion plants to create synthetic fuels from coal. Gasification plants are highly water-intensive and may create an impossible drain on scarce western water resources. In addition to the shortage of water, other environmental concerns are the secondary developmental impacts stemming from the influx of new workers and potential deterioration of air quality due to mine mouth power and gasification plants.

Impact on Air Quality—The use of increasing quantities of coal also has important implications for the emission of air pollutants, which are discussed in the following section on air quality.

Air Quality

Last year's Annual Report discussed progress in implementing the Clean Air Act Amendments of 1970 and focused in particular on the



The scars of strip mining (top) can be repaired through proper reclamation (bottom).

emergence of indirect or secondary impacts of air pollution control on urban transportation, energy, land use, and the economy. During the past year, as a result of the Arab oil boycott, the primary concern became the interrelationship between the pursuit of clean air and the provision of energy. In some respects, the energy crisis was supportive of improved air quality; in other cases, the two goals were conflicting. At the same time, the need to provide additional flexibility under the law became compelling. The result was an extensive debate. In March 1974, EPA transmitted a series of proposed amendments to the Clean Air Act to the Congress. In June the Energy Supply and Environmental Coordination Act of 1974 was signed into law.[73]

Review of Standards

Under the 1970 Amendments, EPA is responsible for establishing national standards of ambient air quality—primary standards to protect health, and secondary standards to protect the public welfare, specifically property, vegetation, and aesthetics. In April 1971, EPA established standards for major air pollutants—sulfur dioxide (SO_2), particulate matter, carbon monoxide (CO), hydrocarbons (HC), nitrogen oxide (NO_x), and photochemical oxidants.[74]

These ambient air standards became the basis for the development of state implementation plans by mid-1972. Under the state plans, polluters are required to install control technology or take other steps so that emissions are reduced to levels which will permit ambient air quality standards to be achieved. The law also requires that new plants, or existing plants undergoing major modification, meet performance standards achievable through the use of best demonstrated technology for reducing emissions.

As implementation of the Clean Air Act has gone forward, questions have been raised about the validity of the levels prescribed in the present standards. In response, two separate re-examinations were undertaken in the past year. In one, the Senate Public Works Committee contracted with the National Academy of Sciences (NAS) to obtain a comprehensive independent evaluation of the primary or health standards.[75] In the other, the Office of Management and Budget requested the Department of Health, Education, and Welfare and EPA to examine existing scientific information on the health effects of sulfur oxides.[76]

The questions directed to the National Academy reflected a broad range of concerns. Some major questions include the adequacy of the scientific data on which standards are based, the margin of safety built into existing standards, the effects of allowable pollutant levels on different population groups (including those especially susceptible as well as normal healthy adults), the existence or nonexistence of "threshold levels," and the proportion of the total health hazard to

the city dweller which comes from air pollution. In the interim report released in October 1973, the NAS found that existing health effects data present "no compelling basis for a change in the present standards." If avoidance of "any adverse physiological change" is the criterion, preliminary information suggested that present standards provide a "modest" safety factor.[77]

The study by HEW addressed many of the same questions for sulfur oxides. The conclusion—that "there is . . . no basis for relaxation of the present standards for sulfur oxides at this time"—was the same. The study emphasized that SO_2 alone is of relatively low toxicity. Danger to health arises when SO_2 is converted into sulfuric acid or sulfates by sunlight, photochemical oxidants, or the catalytic effect of certain particulates in the air. Since these processes are not fully understood, and since epidemiological studies of health effects (particularly from low levels of pollution) are still incomplete, the study concluded that "further scientific information will be required to either validate the present standards or justify alteration in these standards." [78]

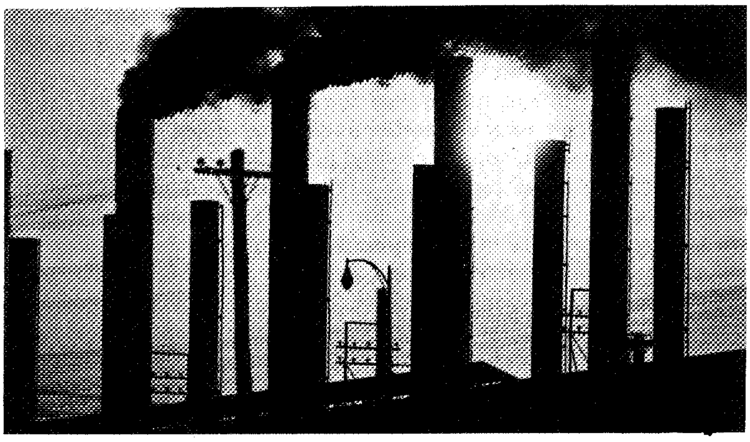
In response to the need for more precise health effects information, the Federal budget for FY 1975 requested about $20 million in additional funds for health effects research.

Energy and Air Quality

The major issues of the past year were related to the interactions between the need for energy and the pursuit of cleaner air. Fuel combustion at stationary sources (including power plants, factories, and residential and commercial heating) is responsible for almost 80 percent of sulfur oxide emissions and over 25 percent of particulate emissions. Automobiles and other forms of transportation contribute over 75 percent of carbon monoxide and over 50 percent of nitrogen oxides.[79] Hence energy policy and air pollution policy are inseparably related.

The major threat to health from stationary sources stems from sulfur oxide emissions. In last year's report, we pointed out that many states had chosen to control SO_2 emissions by regulating the maximum sulfur content of oil or coal allowed to be burned, but that domestic supplies of low-sulfur oil and coal were inadequate to meet the demand established by the state implementation plans. The Arab boycott brought this dilemma to a head and raised both an immediate and a long-range problem. The immediate problem was to cope with the boycott in a rapid and responsive manner and still protect public health. The long-range problem was to devise a policy to permit greater use of domestic coal and still achieve and maintain ambient air quality standards.

The Arab Boycott—The region most affected by the boycott was New England and the Middle Atlantic states. The common approach



The long-range problem is to devise a policy to permit greater use of domestic coal and still achieve and maintain ambient air quality standards.

to comply with SO_2 emission limits in these states was the utilization of low-sulfur fuel. Compliance using this approach in the New York City and Philadelphia areas required use of 0.3 percent sulfur fuel; in Connecticut and the Boston area 0.5 percent sulfur fuel was needed; and in Rhode Island, Maryland, and the remainder of New Jersey 1.0 percent sulfur was necessary.[80] Prior to the boycott, 25 to 30 percent of the residual oil consumed in these states was imported from the Middle East; most of the imports were low sulfur.

During the summer of 1973, EPA developed contingency plans, with special attention to the winter heating oil situation. On October 15, 5 days before the Saudi Arabian oil cutoff, EPA took two actions within the framework of the Clean Air Act to provide the flexibility in environmental regulations necessary to meet a possible winter crisis.[81] First, it issued guidance to 14 states that are dependent primarily on oil for their fuel needs, instituting an expedited procedure to provide short-term variances from sulfur content regulations for power plants and other large oil burning facilities. Second, it identified power plants presently burning oil that could, with less substantial environmental risk, convert to coal. The objective was to establish a regulatory framework capable of meeting a potential winter crisis while at the same time maximizing the possibility of reaching the Clean Air Act's 1975 target date for the attainment of health related air quality standards. A further objective was to encourage utilities and oil and coal suppliers to allocate low-sulfur coal and oil to areas of greatest environmental need. On November 7, 1973, EPA approved the first emergency variance request by a fuel oil supplier in New York State.[82]

Some states chose to grant statewide variances, others granted waivers on a case-by-case basis. In addition, a number of variances

permitted individual power plants to convert from oil to coal. Table 3 summarizes the oil variances that were granted and Table 4 the oil-to-coal conversion waivers.

Based on an analysis undertaken for CEQ, most of the variances were needed at one point or another during the winter. But as a result of efforts by suppliers, consumers, and air pollution authorities and a mild winter, the use of high-sulfur oil was minimized in high priority urban areas. In New York City, for example, Consolidated Edison was granted a variance to burn up to 3 percent sulfur fuel oil, but the fuel oil it actually burned during February and March averaged roughly 0.5 percent sulfur by weight. The experience in Boston and Philadelphia was similar. The average sulfur content of the fuels burned by Boston Edison and Philadelphia Electric was roughly 0.65 percent and 0.8 percent compared with the variance specification of 2.6 percent and 1.25 percent respectively.

The Federal Energy Office (FEO) and EPA developed a preliminary list of 26 power plants which apparently could be converted

Table 3

Residual Oil Variances, Winter 1973–74

	Requested	Approved	Denied	Under review
Region I				
Maine [1]	1	1	0	0
New Hampshire [2]	1	1	0	0
Vermont [2]	1		0	1
Connecticut	2	1	1	0
Rhode Island [3]	2	2	0	0
Massachusetts [2]	4	4	0	0
	11	**9**	**1**	**1**
Region II				
New York	6	6	0	0
New Jersey [2]	1	1	0	0
	7	**7**	0	0
Region III				
Pennsylvania	29	25	4	0
Maryland	8	7	1	0
District of Columbia				
Delaware	16	14	2	0
Virginia	8		0	8
West Virginia				
	61	**46**	**7**	**8**
Regions IV–X	39	2	1	36
Total	**118**	**64**	**9**	**45**

[1] Maine granted a variance to burn high-sulfur oil in Metropolitan Portland.
[2] Statewide variances.
[3] Rhode Island granted a variance to burn high-sulfur oil in all areas except Metropolitan Providence.

Source: Energy and Environmental Analysis, Inc.

Table 4

Oil-to-Coal Conversion Variances, Winter 1973–74 [1]

	Requested	Approved	Denied	Under review
Region I				
Maine	1	0	0	1
Connecticut	2	2	0	0
Rhode Island	1	1	0	0
Massachusetts	4	3	0	1
	8	**6**	**0**	**2**
Region II				
New York	3	2	0	1
New Jersey	5	4	1	0
	8	**6**	**1**	**1**
Regions III–X				
North Carolina	1	1	0	0
Total	**17**	**13**	**1**	**3**

[1] Includes only formal variance requests.

Source: Energy and Environmental Analysis, Inc.

quickly to coal generation with minimal difficulties. These plants had the potential to save approximately 200,000 barrels per day of oil and appeared to be convertible on a short-term basis under current Clean Air Act authorities with the least adverse environmental effects. As of March 1974, 8 of these 26 plants as well as 3 others had converted from oil to coal. These conversions represented an oil saving of 60,000 barrels per day.

These efforts during the Arab boycott were highly successful in protecting the environment in the face of considerable uncertainty about possible energy conditions. With the enactment of the Energy Supply and Coordination Act of 1974, EPA was granted broader authority to temporarily suspend fuel or emission limitations, should a similar emergency develop in the future.

Use of Coal—For the longer term, the Arab boycott made clear that the United States must move towards the capability of self-sufficiency in energy. This capability, in turn, would require greater future use of coal with both low and high sulfur content. The policy problem was to permit increased use of coal without violating ambient air quality standards.

In large measure this was not a new issue; last year's Annual Report discussed the shortage of clean fuels and the impossibility of having stack gas cleaning technology fully operational in more than a few of the power plants requiring major SO_2 reductions until after the statutory deadlines in the 1975–77 period. But the fact that the deadlines were drawing near, in combination with the desire to use more coal, gave the problem an added urgency.

Studies conducted by EPA, FEA, and the Bureau of Mines during the past year all concluded, to varying degrees, that there will be insufficient supplies of low-sulfur coal to meet clean air standards without employing scrubber technology or use of intermittent control systems.[83] For 1975, the three studies were in substantial agreement that the "clean fuel" deficit would approximate one-third of expected U.S. coal production or 200–243 million tons. For the 1975–80 period, however, the conclusions differed as a result of differing assumptions about geographical redistribution of coal, industrial and commercial coal demand, and supplies of low-sulfur coal and scrubbers. The Bureau of Mines forecast that the low-sulfur coal deficit would increase to 275 million tons in 1980 and that, even with installation of scrubbers, issuance of limited variances, and redistribution of coal supplies among air quality control regions, the clean fuel deficit would be 190 million tons in that year. EPA in contrast concluded that ambient standards could be achieved by 1980 through increased production of low-sulfur coal, installation of scrubbers, and geographical redistribution of coal. The FEA study forecast a 1980 deficit of 100 million tons.

Against this background of a potential deficit in clean fuels, four issues dominated attention over the past year: stack gas scrubbers, intermittent controls, coal conversion, and geographical redistribution of clean fuels. High points came in March when the Administration submitted proposed amendments to the Clean Air Act and in June when the Energy Supply and Environmental Coordination Act of 1974 was enacted.

Stack Gas Scrubbers—The adequacy of flue gas desulfurization systems, known as stack gas scrubbers, is one point of controversy. This technology permits high- or medium-sulfur fuels to be burned with removal of the sulfur after combustion but before emission to the atmosphere. In 1971, EPA concluded that this technology was sufficiently advanced to be applied to major fuel-burning installations. Subsequently, a number of oil-burning power plants in Japan as well as the United States installed and operated such systems. But a large fraction of the U.S. utility industry holds that scrubber technology is not sufficiently developed and is resisting a commitment to this technology.

In October 1973, EPA conducted hearings to assess the situation. Utility representatives testified that stack gas cleaning was unreliable and costly and created difficult sludge disposal problems. The EPA hearing panel concluded, however, that the reliability had been sufficiently demonstrated on full-scale units to warrant widespread commitment by the electric utility industry.[84]

In March, the Kentucky Public Service Commission permitted the Louisville Gas and Electric Company, one of the leaders in the United States in developing, demonstrating, and successfully operating a scrubber system, to install only two of four requested scrubbers on

the grounds that scrubber reliability and effectiveness had not yet been demonstrated.[85] The EPA Administrator intervened and requested a rehearing, contending that the case had national significance because other utilities could use the Kentucky example as justification for noncompliance with sulfur dioxide emission requirements.

In April, to remove a disincentive for utilities to install scrubbers, EPA requested state public utility commissions to allow an automatic pass-through of stack gas cleaning R&D, installation, and operating costs similar to the pass-through now allowed by many commissions for increased costs of low-sulfur fuel. This was requested so that costs would be equalized for these two methods of pollution control. Although many of the automatic pass-throughs for fuel costs were not intended to accommodate costs of pollution control, such orders have in fact made the use of scarce low-sulfur fuels a preferred control alternative to installing scrubbing systems.

In July, EPA issued a strategy document for the control of sulfur oxides from electric power plants. In it, EPA recognized that very few electric utilities have adequate experience with flue gas desulfurization technology at this time. It therefore proposed to encourage early installation of this technology on at least one facility in each appropriate utility system in order to obtain experience and permit more effective application to subsequent facilities.[86]

Intermittent Controls—A second and related point of controversy concerns the use of intermittent control systems—techniques which disperse and dilute pollutants by the use of tall stacks and various operating practices, including a switch to low-sulfur fuels during inversions and other unfavorable meteorological conditions. Many utilities and several Federal agencies believe that intermittent controls, when used properly, can meet present ambient air standards in a way which is less expensive, uses less energy, results in less solid wastes, and could encourage the opening of new coal mines. Although EPA has authorized intermittent controls on an interim basis, it opposes their permanent use. EPA believes that sulfates formed from SO_2 emissions are causing public health problems, that permanent controls to prevent sulfur emissions therefore may be necessary in the future to protect public health, and that the costs of control could be greater in the long run should new requirements to control sulfates force expensive retrofits.

The substantive issue related to intermittent control systems was clouded by the question of whether its permanent use is authorized under the Clean Air Act. In February, the Fifth Circuit Court ruled that dispersion techniques such as intermittent control systems are acceptable only if permanent controls are not achievable or feasible.[87] In March, an amendment to permit indefinite use of intermittent control systems was transmitted to the Congress by EPA but not supported by it. The Congress did not hold hearings on the proposal.

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Conversion to Coal—One approach to reducing oil imports is to require power plants and industrial plants to switch from oil or natural gas to coal. In November, the President proposed legislation to effect this.[88] The emergency energy legislation considered by the Congress during the winter contained differing authority, criteria, and procedures for such conversions. With the enactment of the Energy Supply and Environmental Coordination Act in June, sharply limited authority for conversion to coal became law.

The new law provides that the FEA must prohibit power plants (and may prohibit other major fuel-burning installations) from using oil or gas if (1) conversion is practicable, (2) coal will be available, and (3) reliability of electric power plants will not be impaired. However, an FEA order to undertake such a conversion will not become effective until EPA determines that the source can comply with EPA-imposed air pollution requirements. Specifically, if the source is located in an air quality control region in which the primary national ambient air quality standard for a pollutant is not being met, the emission-limiting regulations of the applicable state implementation plan must be complied with. In other air quality control regions, EPA must specify requirements to assure that primary ambient air quality standards are not violated. In all cases, a source is not to proceed to convert to coal until EPA approves a schedule under which the source must comply with emission requirements as soon as practicable but no later than January 1, 1979.[89] FEA is required to comply with the provisions of NEPA for any prohibitions lasting longer than 1 year.

Geographical Redistribution of Clean Fuels—The overall national shortage of clean fuels is aggravated because some states have established SO_2 emission limitations on a statewide basis, meaning that undeveloped areas already meeting both primary and secondary standards are also required to use low-sulfur fuels. In addition, some states have established emission limitations more stringent than those necessary to meet national ambient standards. To obtain a more optimal use of these fuels, EPA has since 1972 been encouraging states to postpone low-sulfur fuel requirements where they are not needed to meet national ambient air quality standards. This action would allow the scarce low-sulfur fuels to be used in other areas where they are needed to meet standards.

In March, EPA proposed an amendment to permit extension (for purposes of Federal enforcement) of deadlines for meeting limitations more stringent than needed to meet primary standards. The Energy Supply and Environmental Coordination Act took a different and less forceful approach.[90] It directed EPA to review each state's implementation plan and report to the state on whether the plan can be revised with respect to stationary sources without interfering with attainment and maintenance of national air quality standards. If the state then chooses to revise its plan, EPA is directed to approve

the revisions. Whether the states will take action is not yet clear. If they do not act, this opportunity for reducing the clean fuels deficit will be lost.

Automobile Emissions

The energy crisis also raised issues concerning the control of pollution from automobiles.

The 1970 Amendments to the Clean Air Act required by 1975 a 90 percent reduction in HC and CO emissions below the allowable emission level of 1970 cars, and by 1976 a 90 percent reduction in NO_x emissions below the average level of 1971 model year cars sold outside California. The Act provided that EPA could, if technology were not available and if other criteria were met, extend the deadlines for 1 year each. In April 1973, the Administrator granted an extension for the 1975 statutory standards and imposed less stringent interim standards instead.[91] Table 5 compares emission limits under the various Federal standards since 1968.

In order to meet the 90 percent control levels within the time allowed, U.S. automakers in the early 1970's settled on one basic approach to cleaning up their engines—catalysts. They decided that from their standpoint catalyst technology represented the only approach which had a high probability of reducing emissions to the required levels while at the same time protecting their capital, manpower, and technical investments in the conventional internal combustion engine. Others, including a panel of the National Academy of Sciences, criticized the catalyst approach as not durable and not consistent with good fuel economy, and held that adoption of the stratified charge technology was a preferable near-term approach.[92]

Table 5

Automobile Emissions, 1957–67, and under Federal Standards, 1970-75

[In grams per mile][1]

	Hydro-carbons	Carbon monoxide	Nitrogen oxides[2]
1957–67 autos, averaged	8.7	87	
1970/71 Standards	4.1	34	
1972/73/74 Standards	3.0	28	[2]3.1
1975 Interim standard			
United States	1.5	15	3 1
California	0.9	9	2.0
Statutory standard	0.41	3.4	0.4

[1] All values are expressed in terms of the 1975 Federal emission test procedure.
[2] The NO_x standard became effective with the 1973 models. California's NO_x standard of 2.0 grams per mile became effective with the 1974 models.

Source: Energy and Environmental Analysis, Inc.

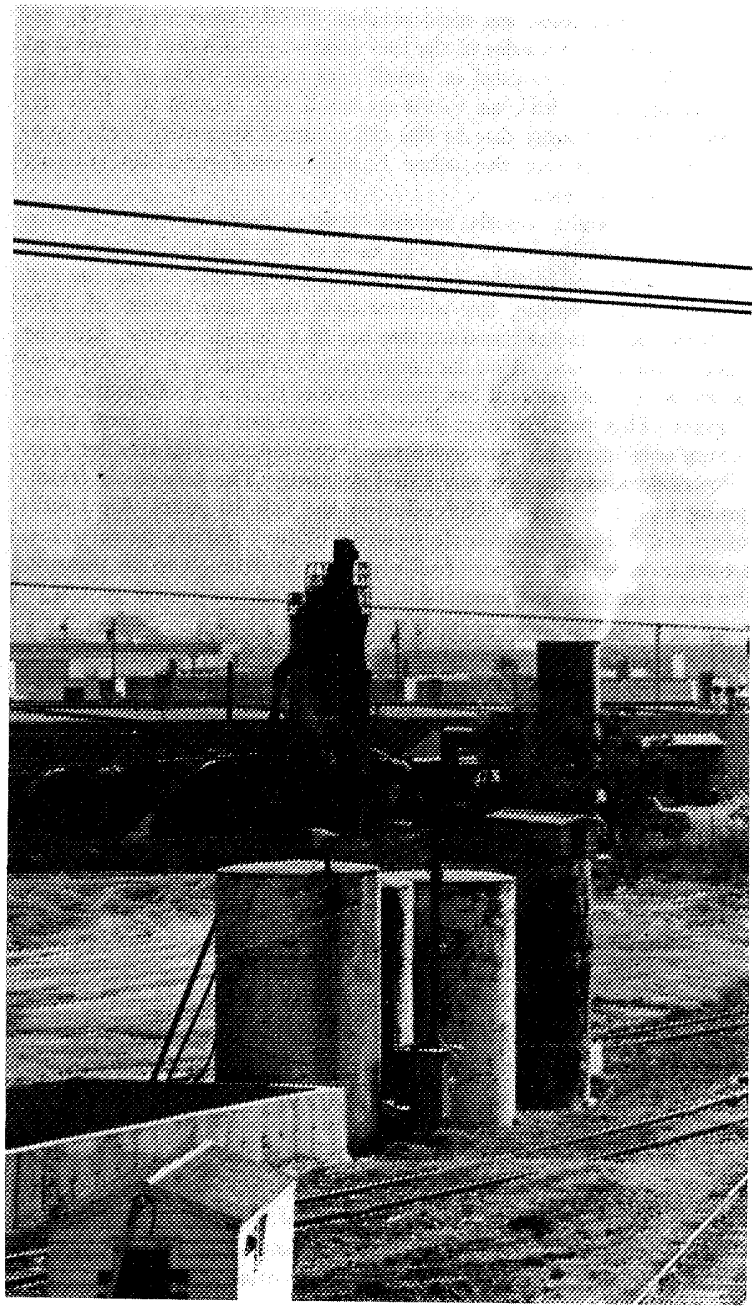
At the time that the interim standards were adopted, the Administrator approved special standards for California that in effect would require American automakers to install catalysts in most 1975 model cars sold in that state, whereas in the other 49 states it would have been possible to meet the less stringent interim standards, on most cars, without catalysts. Hence the interim standards were expected to result in a phasing in of the catalyst technology. However, American automakers subsequently decided to install catalysts on most of their 1975 cars.

In the summer of 1973, an unexpected issue arose concerning a potential health hazard from catalysts. Gasoline contains small quantities of sulfur, generally on the order of 0.01 percent for regular leaded gasoline and 0.02 for premium leaded gasoline and unleaded gasoline.[93] When combusted in an automobile without a catalyst, the sulfur is oxidized and released primarily as SO_2. Because total quantities of SO_2 from all cars are small (in the range of 1 percent of all SO_2 in the air), these emissions had been of limited concern. But new data indicated that catalysts tend to convert the sulfur into sulfates, a more dangerous form. Since these sulfates would be released at street level, there would be a potential health hazard in areas of heavy auto traffic.

After careful review of the limited and conflicting data, EPA determined that the maximum amount of sulfates which would be produced from the 1975 model cars would be insufficient to create a health hazard. Nevertheless, the potential seriousness of the problem warranted further intensive study. Accordingly, EPA decided that the best course was to allow the automakers to proceed as planned with installation of catalysts in the 1975 model year cars while the necessary data were collected and studied. In addition to seeking a better definition of the possible health hazard and of techniques for reducing or controlling sulfur emissions in the vehicle system itself, the study would examine the costs involved in removing sulfur from gasoline during the refining process.

Auto Fuel Economy—With the initiation of the Arab embargo, public attention focused on fuel economy and ways to conserve gasoline. Average fuel economy of automobiles had been decreasing over the last 10 years, owing to exhaust emission controls, increases in vehicle weight, and increased use of power accessories.

According to data from a report by EPA,[94] the control of exhaust emissions on 1973 model cars had decreased fuel economy on a sales weighted average basis by 10 percent as compared to precontrolled cars. Anticipating the need to use lead-free (and therefore lower octane) gasoline on catalyst-equipped cars (lead had been shown to poison catalysts), U.S. automakers began to lower compression ratios in 1971. EPA data indicated that 3.5 percent of the loss in fuel economy was attributable to each whole number drop in compression ratio. The use of retarded spark timing to control HC



Smog, shown here enveloping Dallas, is caused primarily by automobile emissions.

and CO, and exhaust gas recirculation (EGR) to control NO_x, accounted for the remainder of the fuel economy losses due to emissions control. Since NO_x control on small cars requires little or no EGR, the leaning out of fuel/air ratios on small cars tended to offset the losses in fuel economy due to the other emission control techniques used. Large cars, on the other hand, showed penalties ranging from 14 to 18 percent.

Increased weight was the second cause of reduced fuel economy. The average weight of the cars in each of the five major categories of automobiles has increased by 300 to 1,000 pounds during the last 12 years. For example, the intermediate size automobiles of 1973 weigh the same as the standard size car of a decade earlier. And the effect of vehicle weight on fuel economy is dramatic; a 5,000-pound luxury car gets 50 percent less fuel economy than a 2,500-pound subcompact. This penalty due to weight increases was in part offset because consumers have been buying larger numbers of smaller cars.

Power options also decreased fuel economy. The sale of air conditioning has increased ninefold during the last 10 years. Air conditioners not only add to vehicle weight but they require power when in operation which reduces fuel economy by from 9 to 20 percent. The use of automatic transmission also reduces fuel economy, but by a smaller amount.

However, the fuel economy of 1975 models does not look entirely bleak. Tests of prototype vehicles indicate that 1975 cars can be expected to have better fuel economy than 1974 models due to the use of the catalytic converter rather than spark retard as a means for controlling HC and CO emissions. The use of the catalyst will permit the engine to be tuned for better economy rather than reduced emissions, with the catalyst oxidizing the unburned HC and CO to harmless CO_2. EPA has predicted a gain of 8 percent for 1975 cars over 1974 models, calculated on a constant sales weighted basis, due to the change in emission control technology.[95] Automakers plan other changes in their 1975 models which are also expected to improve mileage, such as greater production of smaller models, greater use of radial tires, emphasis on smaller engines, and lower axle ratios.

Nevertheless, in the context of the energy crisis, the need for even further improvements in fuel economy was judged to be paramount. Therefore, in his January 1974 energy message President Nixon recommended that the interim 1975 emission standards for CO and HC be extended for 1976 and 1977, and that the NO_x standard be fixed at 3.1 grams per mile for the same 2 years. The President stated that this freeze would "permit auto manufacturers to concentrate greater attention on improving fuel economy . . . without significant effect on our progress in improving air quality." [96]

The Energy Supply and Environmental Coordination Act provided a more limited extension. For HC and CO, the 1975 interim standards were extended for 1976; for 1977 model year vehicles, on ap-

plication from an automobile manufacturer, the EPA Administrator was authorized to suspend the statutory standard and prescribe interim standards for these two pollutants; for 1978, the statutory standard would apply. With regard to NO_x, the new law extended the interim standard of 3.1 grams per mile through 1976, established a standard of 2.0 grams per mile for 1977, with reversion to the statutory standard of 0.4 grams per mile for the 1978 model year.[97]

Transportation Control Plans—The proposed Clean Air Act Amendments also provided a procedure for extending the deadlines for some of the 38 metropolitan areas now implementing transportation control plans. As described in last year's Annual Report, some cities such as Los Angeles cannot achieve primary standards by 1975–77 without serious social or economic effects. The proposed amendment would permit these cities to obtain deadline extensions of up to 5 years on the condition that all additional reasonable measures are implemented during the period. If needed, an additional 5-year extension could be granted, although EPA expects that only a few cities, such as Los Angeles, will need it. Congress has yet to act on this amendment.

The energy crisis had the effect of encouraging transportation developments which can have a positive impact on air quality in the longer run. It led automakers to accelerate their work on the stratified charge engine, light-weight diesel engine, and other new engine systems which carry promise for improved mileage as well as inherently lower pollution emissions. Just as important was the new emphasis on mass transit and car pooling, both of which can reduce vehicle miles travelled in urban areas. Chapter 3 describes some preliminary data on reduced pollutant levels during the winter months. In effect, the gasoline shortage in those months had some of the same effects on transportation patterns in urban areas that are intended as a result of transportation control plans. Although auto use picked up again once the Arab embargo was lifted, the longer-term imperatives of the energy crisis promised to lend support for more mass transit, smaller and more efficient automobiles, and new patterns of land use, which together would reduce future emissions of auto pollutants in urban areas.

Effects on Land Use

The development of a region has impact on the quality of its air, whether from new stationary sources such as factories or power plants or from increased automobile traffic. For this reason among others, the Clean Air Act requires new plants and factories to meet emission standards based upon the best available demonstrated control technology and processes. During the past year, EPA took action in response to court decisions in two additional areas bearing on the

relationship between air quality and land use: indirect sources and significant deterioration.

Indirect Sources—In January 1973, the U.S. Court of Appeals for the District of Columbia ordered that all states submit revisions of their implementation plans to provide for preconstruction review of indirect sources of air pollution—facilities such as major urban roadways, shopping centers, and airports, which attract large numbers of vehicles whose emissions might violate ambient air quality standards.[98] In February 1974, EPA issued final regulations.[99]

The regulations are intended to be administered by state and local governments. Facilities requiring review include new urban highway sections which will carry more than 20,000 vehicles per day, new airports expected to have 50,000 or more aircraft operations per year, and new parking areas with more than 1,000 spaces in urban and 2,000 spaces in nonurban areas. The objective is not to prevent development but to foster good planning and design practices. The regulations will affect indirect sources which are constructed or modified after December 31, 1974.

Significant Deterioration—Last year's report described the first steps of the controversy surrounding the nondegradation issue. Several environmental groups brought suit against EPA, arguing that the Clean Air Act required disapproval of any state implementation plan which allowed significant deterioration of air quality in regions having cleaner air than required by Federal primary and secondary ambient air quality standards. The environmental groups argued that one clause under the Act's stated purposes, ". . . to protect and enhance the quality of the nation's air resources" in effect required maintenance of air quality cleaner than that judged necessary to protect health and welfare.[100] The issue reached the U.S. Supreme Court which, with a 4–4 vote, let stand the District Court decision requiring EPA to promulgate regulations establishing a mechanism for preventing significant deterioration.

The court decisions, however, did not define what should constitute "significant deterioration." It was clear that any national effort to prevent deterioration would have major economic, social, and other effects. Therefore EPA in July 1973 issued proposed regulations to initiate a public debate.[101] The regulations offered four alternative approaches to the definition of significant deterioration in clean air regions. The first proposed a national limit on increases in ambient pollution levels, the second a ceiling on emissions in "clean air" regions. The remaining two defined procedures which might be followed by the states, one zoning the state into regions of allowable deterioration, the other permitting case-by-case decisions on whether a new source would constitute significant deterioration.

During the debate on the draft regulations a variety of technical, economic, social and energy issues were explored. In March, the choice before the Nation was more clearly defined when EPA trans-

mitted for the Administration a proposed amendment to the Clean Air Act which would remove the authority of the Federal Government to promulgate standards more stringent than those necessary to protect health and welfare.[102] This proposal reflected the view of other agencies that Federal regulation to prevent nondegradation would represent an unnecessary and unwarranted limitation on the range of choice of state and local governments in economic development and land use matters. Authority existing in the Act which allows states to establish more stringent air quality standards than required by the Federal Government would not be affected. At the same time, EPA stated its belief that areas with high air quality can be protected through classification by the states of geographic areas into one of three general classes: areas of restricted growth, such as parks and wildlife refuges; areas of moderate growth; and areas where growth would not be restricted so long as secondary air quality standards are not violated.

The future of the nondegradation issue is as yet unresolved. EPA expects that any forthcoming regulations may be challenged in court, and Congressional review of the proposed amendment has not yet taken place.

Solid Waste

Last year, in discussing *Resource Recovery: The State of Technology,* a study for CEQ, we reported that technology was not a barrier to increased resource recovery from solid wastes.[103] Instead, the major obstacle was the absence of markets for the resources recovered. In the ensuing year, the rise in the price of energy has radically changed this situation and created markets where none existed before. The result is that market forces are now activated which promise simultaneously to reduce the problem of disposing of solid wastes and to provide needed resources in the form of energy as well as reusable raw materials.

Less encouragingly, Congress has yet to take final action on another element of the waste disposal problem—the environmentally safe disposal of hazardous wastes.

Energy Recovery

Three trends became evident over the past year which produced an increased interest in the use of municipal solid waste as a source of energy and of recycled materials. First, rising costs and decreased availability of conventional fossil fuels tended to make solid waste an attractive energy source. Second, the cost of conventional disposal methods such as sanitary landfill and incineration continued to rise. Third, the value of recoverable waste materials—particularly scrap metal and paper—rose significantly, in part because higher energy

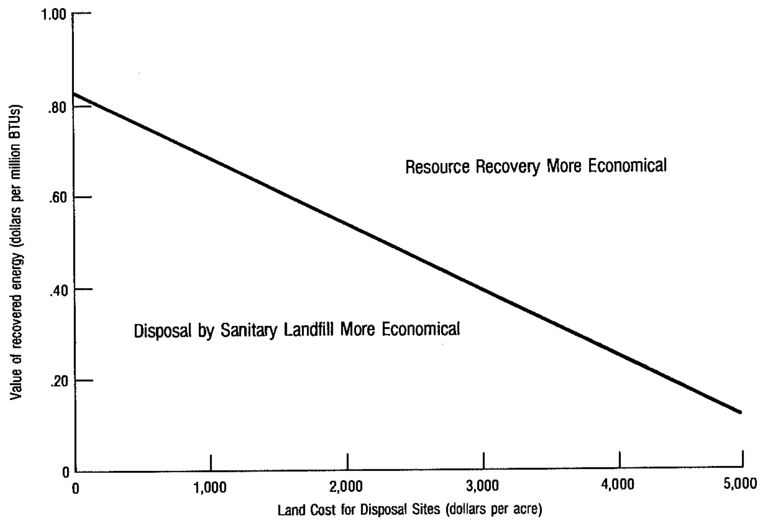
costs increased the market price of virgin materials. As a result, a number of resource recovery techniques, especially those combining recycling of the heavy components of the wastes with combustion of the light components to recover energy, became economically competitive with traditional landfill and incineration disposal techniques.

Costs of incineration of solid waste range from $10 to $20 per ton. Costs of sanitary landfill average between $3 and $13 per ton but can be much higher in particular locations, especially where land values are high or where lack of suitable sites nearby necessitates transporting wastes to remote landfill sites. The net cost of resource recovery must be more favorable than the costs of incineration or landfill in order to be competitive on an economic basis.

Figure 1 compares the projected economics of resource recovery with sanitary landfill operation. The resource recovery system specified here is designed to process 1,000 tons per day, removing ferrous metals by magnetic separation and then converting the combustible residual into energy. The net disposal cost of this system after ferrous metals are removed is about $8 per ton, although costs will vary with each location. Hence, to be economical, the system requires that the energy value of the residual be sufficient to reduce net disposal cost to a point below that of a sanitary landfill.

Figure 1

Equivalence Between Land Cost and Energy Value



Source: Environmental Protection Agency, Resource Recovery Division.

The figure provides a quick reference for determining whether landfill or resource recovery is the preferred alternative. At $0.30 per million BTU, land costs would have to be around $3,000 per acre before resource recovery would be more economical. At $0.80 per million BTU, resource recovery is less expensive than sanitary landfill regardless of land costs.

Energy prices are now at a level that makes resource recovery attractive. During the Arab embargo, crude oil on the international spot market reached a peak of $25.00 per barrel or over $4.00 per million BTU. Average price has been in the range of $7.00 per barrel, but it is not expected to fall below $4.50 per barrel or $0.75 per million BTU. Hence, even allowing for a 20 percent reduction in the value of solid waste as fuel because of handling problems, energy recovery now provides a very attractive alternative to traditional disposal methods except where land is cheap.

Recovery of the energy value of waste material can be accomplished through several different technology systems, including:

1. Incineration with steam recovery—burning solid waste and recovering steam and the noncombustible inorganic fraction after incineration.
2. Shredded waste as a fuel—shredding refuse and separating it into light and heavy components. The light component is suitable as a fuel in utility and industrial boilers. Ferrous and non-ferrous metals and glass are separated and recycled.
3. Pulped waste as a fuel—wet pulping of refuse during which organic and inorganic components are separated. The organic component is dried and used as a fuel; the inorganic components are recycled.
4. Pyrolysis to produce oil or gas—chemically decomposing waste in a high-temperature and low-oxygen atmosphere. The process produces fuel oil and gas which, after treatment, can be used as fuel substitutes. The heavy inorganic component is separated prior to pyrolysis and recycled.
5. Incineration with electricity generation—using the gases from high pressure incineration to drive a gas turbine electric generator.

In recovering energy from solid waste, full attention must be given to protecting the environment. In particular, air pollution emissions need to be carefully controlled. Technology to accomplish this objective is reasonably well established.

The combination of increased costs for fuel and land, together with the emergence of proven recovery technologies, has stimulated great interest in resource recovery at the state and local level. At least 18 cities are now actively considering energy recovery systems. Three cities have facilities under construction, and several others are in the advanced planning stage. In addition, at least 30 more cities are evaluating energy recovery systems. Table 6 summarizes activities in various cities as of April 1974.

Table 6

Projected Implementations of Energy Recovery Systems by 1980

Location	Tons per day	Description
California		
San Diego County	200	Pyrolysis; EPA is sponsoring project to demonstrate the Garrett Research and Development system; oil produced will be accepted by San Diego Gas and Electric; project in engineering design phase.
Connecticut		
Bridgeport	1,200	Solid waste as fuel; state-wide resource recovery authority is reviewing proposals, Northeast Utilities will accept the fuel.
District of Columbia	1,000	Solid waste as fuel; D.C., Fairfax County, Arlington County, the City of Alexandria, and the Metropolitan Washington Council of Governments are studying the feasibility of a supplemental fuel system on a region-wide basis. Virginia Electric Power Company and Potomac Electric Power Company are cooperating in the studies.
Illinois		
Chicago	2,000	Solid waste as fuel; construction started in early March, Commonwealth Edison will accept the fuel.
Chicago area excluding the City	1,000	Solid waste as fuel; several suburbs have approached Commonwealth Edison to determine the feasibility of implementing supplemental fuel systems
Iowa		
Ames	200	Solid waste as fuel; construction to begin by June 1974; municipal electric utility will accept the fuel.
Maryland		
Baltimore	1,000	Pyrolysis; EPA is sponsoring project to demonstrate the Monsanto system; pyrolysis gas will be combusted on-site to generate steam for sale to Baltimore Gas and Electric; plant will be operational in early 1975.
Montgomery County	1,200	Solid waste as fuel; County is planning project with Potomac Electric Power Company cooperation; feasibility study has been completed; County Council and County Executive have approved the plan.
Massachusetts		
Braintree	240	Water wall incineration; plant has been operating since 1972; contract signed early 1974 for sale of steam to Weymouth Art Leather Co.
East Bridgewater	1,200	Solid waste as fuel; privately financed processing facility; Weyerhauser is accepting the fuel for its industrial steam boilers.
Saugus (near Boston)	1,200	Water wall incineration; plant under construction; steam product will be sold to General Electric Co. for process steam.
Lawrence	1,000	Solid waste as fuel; Lawrence will be the first implementation under the statewide solid waste master plan approved in early 1974; master plan calls for supplemental fuel production for steam and steam-electric boilers, and materials recovery.

Table 6—Continued

Projected Implementations of Energy Recovery Systems by 1980—Continued

Location	Tons per day	Description
Missouri		
St. Louis	8,000	Solid waste as fuel; Union Electric Company plans to implement, by mid-1977, a system to handle the residential, commercial and selected industrial waste from the entire metropolitan area; Union Electric will process raw waste, recover magnetic metal, aluminum, and glass as well as fuel.
New Jersey		
Essex County	1,000	Solid waste as fuel; request for proposals being prepared; supplemental fuel to be accepted by Public Service Gas and Electric or other industrial steam boilers.
Hackensack-Meadowlands	2,000	Solid waste as fuel; detailed proposals are currently being reviewed; it is anticipated that the fuel will be accepted by Public Service Gas and Electric or industrial steam boilers.
Union County-Middlesex County	1,000	Solid waste as fuel; feasibility of producing a supplemental fuel for Public Service Gas and Electric is being assessed.
New York		
Albany area	500	Solid waste as fuel; feasibility of producing supplemental fuel for industrial steam boilers, state-owned heating plant and municipal electric utility is being assessed.
Hempstead	1,000	Detailed proposals have been received for design and construction of energy and materials recovery systems.
Monroe County	500	Solid waste as fuel; feasibility study to produce a supplemental fuel for Rochester Gas and Electric completed; request for proposals being prepared.
New York City	2,000	Solid waste as fuel; City has completed feasibility study of using waste as supplemental fuel in Consolidated Edison's boilers; City writing request for proposals to design and construct supplemental fuel facility; City and Consolidated Edison plan contract to determine feasibility of designing new steam-electric boiler to burn 50 percent solid waste.
Westchester County	1,500	Feasibility study completed; County most interested in energy recovery for County-owned industrial park.
Ohio		
Akron	1,000	Water wall incineration; detailed engineering study is underway; steam product will be used for downtown heat and air conditioning and for B.F. Goodrich process steam.
Cleveland	500	City has received bids for a steam generation system; the super-heated steam will be used for electric generation by the municipal utility.

Table 6—Continued

Projected Implementations of Energy Recovery Systems by 1980—Continued

Location	Tons per day	Description
Oregon		
Lane County	700	Solid waste as fuel; feasibility study completed to use waste as supplemental fuel in a Eugene municipal steam power plant that currently burns wood waste; additional waste fuel is required because wood wastes are becoming scarce.
Pennsylvania		
Philadelphia	2,400	Solid waste as fuel; Combustion Equipment Associates has announced plans to construct and operate, with private financing, a facility to produce supplemental fuel for industrial steam boilers.
Puerto Rico		
San Juan	1,000	San Juan planning to initiate feasibility study for a solid waste as fuel system; supplemental fuel would be used by Commonwealth-owned San Juan steam-electric station.
Tennessee		
Knoxville	500	Pyrolysis; TVA is studying feasibility of implementing a Torrax gas pyrolysis system to produce gas as supplemental fuel for TVA steam-electric boiler.
Memphis	500	Solid waste as fuel; detailed proposals have been requested to implement a wet processing system to produce supplemental fuel for a TVA steam-electric boiler.
Nashville	750	Water wall incineration; construction is complete; public authority has been formed to construct and operate the facility; steam product will be used for downtown heating and air conditioning.

Source: Environmental Protection Agency, April 1974.

Table 7 shows the national potential for generating energy from municipal solid waste. It presents: (1) an estimate of the theoretical energy value of the national solid waste stream; (2) the amount of wastes economically available for energy recovery; (3) the energy value of the solid waste generated by those cities (SMSA's) which are the immediate potential candidates for energy recovery systems; and (4) the presently planned projects.

The theoretical energy value estimates the energy recoverable in 1971 and 1980 if all solid waste in the United States were converted to energy. The estimate of the amount of energy recovery actually available is based on solid waste generated in Standard Metropolitan Statistical Areas (SMSA's). (Energy recovery appears feasible only in more densely populated areas such as SMSA's.) The estimate of potential projects is based on a study conducted by EPA which iden-

Table 7

Energy Potentially Recoverable From Waste

	1971		1980	
	BTUs (billions)	Barrels of oil per day (thousands)	BTUs (billions)	Barrels of oil per day (thousands)
Theoretical energy value	1,675	819	2,154	1,054
Available energy value	967	473	1,259	616
Potential projects			647	317
Presently planned projects			85	42

Source: Environmental Protection Agency.

tified 48 SMSA's where energy recovery could be feasible by 1980.[104] The final category shows the energy value of recovery projects existing or planned at the present time.

Table 7 shows that the amount of waste available in sufficient quantity to justify resource recovery is significantly greater than the capacity of planned resource recovery systems. If energy prices stabilize at or above their current levels and land values continue to increase, many if not most of the potential candidates will find energy recovery of solid waste an attractive alternative to conventional disposal techniques by 1980.

Materials Recovery

Municipal and industrial solid wastes are also a potential source of reusable materials. Less energy is generally required to reprocess waste materials than to develop virgin materials, when all aspects of acquisition, processing, and transportation are considered. Hence the rise in energy prices over the past year greatly strengthened the secondary material market.[105]

Iron and Steel—During 1973, nearly 60 million tons of secondary iron and steel, a record amount, was purchased for recycling purposes. Prices of steel scrap rose to peak levels. No. 1 Heavy Melting Scrap, for example, sold for $160 per ton compared to $45 per ton a year before. Junk auto bodies, nearly worthless a few years ago, brought as much as $50 each.

Aluminum—Aluminum prices are extremely sensitive to energy costs. At the same time, it requires only 5 percent as much energy to produce aluminum from scrap as from virgin ore. Since 1967, the price of scrap aluminum has risen more than 75 percent, and in the spring of 1974 three manufacturers announced a 50 percent in-

Rising energy prices greatly strengthened the secondary material market. Junked autos, formerly of no value, now bring as much as $50 each.

crease—from 10¢ to 15¢ per pound—in the price paid for scrap aluminum cans. Even before this increase, 15 percent of aluminum cans sold were recycled in 1973, as compared with only 5 percent in 1970.

Copper—About half the copper produced in the United States now comes from recycled scrap. Since 1967, prices for scrap have risen by 100 percent.

Lead—Auto batteries are a source of easily recoverable lead. Since 1971, prices of battery lead have increased fourfold.

Paper—A paper shortage was experienced during the past year, in part because of greatly increasing export demand. Secondary paper requires much less energy, and prices have been rising to a degree which has led over 125 cities to conduct separate newspaper collection programs. The price of high-grade corrugated paper, which in 1972 sold for $20 per ton, rose as high as $65 per ton in the past year.

Hazardous Wastes

Environmentally safe disposal of hazardous residues—toxic chemical, biological, flammable, and explosive wastes—represents another aspect of the waste problem. In last year's Annual Report, the Coun-

cil discussed the gap in Federal legislation governing the disposal of hazardous wastes on land, a problem compounded by the existence of statutes limiting and controlling the release of these substances into the air, water, or the oceans. Unfortunately, the Administration's proposal to close this major regulatory gap, the Hazardous Waste Management Act, has languished in Congress since its introduction. Yet the serious risks to human health continue to exist and to grow.

In a report submitted to the Congress in 1973,[106] EPA estimated that roughly 10 million tons per year of chemical and biological hazardous wastes were generated in 1970, and the total is growing at a rate of 5 to 10 percent annually. Ninety percent of these wastes occur in liquid or semiliquid form.

In the absence of adequate regulatory programs, much of these wastes is being dumped, buried, or injected on or into the land. The potential for damage to public health and environmental quality is great, particularly if the uncontrolled waste disposal leads to pollution of groundwater, runoff to surface waters, and contamination of drinking water wells.

The technology for controlling hazardous waste disposal exists for most substances. However, since adequate treatment and disposal can be 10 to 40 times more expensive than environmentally unacceptable methods, improvement is not likely until legislation and regulation compel it.

Water Quality

Last year's Annual Report described the extended debate preceding the Nation's adoption of a comprehensive new law for the cleanup of the country's waters—the Federal Water Pollution Control Act Amendments of 1972 [107]—and summarized the complex features of the law. During the past year, the difficult process of implementing this new authority moved forward. The new law required fundamental changes in approach by all institutions involved in water pollution control—Federal, state, and local governments and private industry—and in some areas the deadlines established by the law could not be met. Nevertheless, considerable progress was achieved, and the groundwork was established for more rapid forward progress in the immediate future.

The Basis for Effluent Limitations—The 1972 Amendments require that every "point source" discharger of pollutants obtain a permit which specifies the allowable amount and constituents of his effluent.[108] The permit also contains a schedule specifying the dates by which the discharger will achieve compliance. Permits are issued by states which have met requirements established by the Administrator of the Environmental Protection Agency, with individual per-

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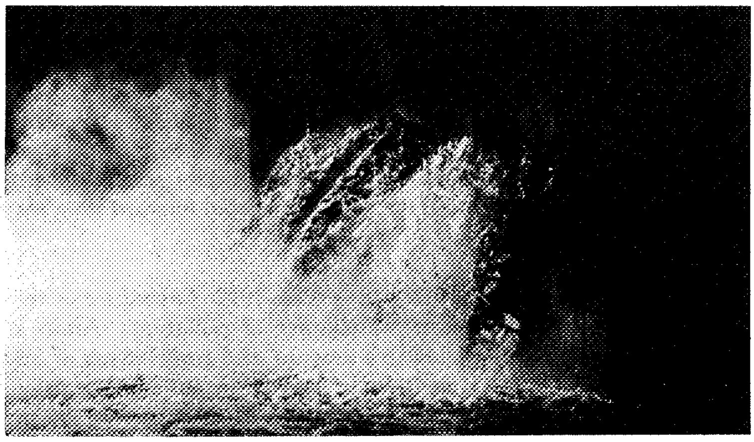
mits subject to EPA review. In states that fail to seek or carry out an approved permit program, EPA itself issues the permits.[109]

The basis for the permit for a point source discharger is both a technology-based effluent standard and a water quality standard. The effluent standard represents the pollution reduction achievable by the application of the best practicable control technology for that class and type of discharger on a national basis.[110] All dischargers must at a minimum meet this standard. The water quality standard is used to determine whether additional pollution reduction is environmentally necessary if the particular stretch of water on which a discharger is located is to be used for its designated purpose. If the water quality standard cannot be met on the basis of the effluent standard alone, then additional pollution reduction may be required.[111]

The technology-based effluent standards are to be applied in two phases. By 1977, municipal treatment plants must provide secondary treatment,[112] and all industrial point source discharges must meet standards based on "best practicable control technology currently available." [113] Industries discharging into municipal sewers do not need permits but must meet applicable pretreatment requirements. For 1983, the standards are tighter: municipalities must provide the "best practicable waste treatment technology" [114] and industrial point sources must comply with guidelines prescribing "best available control technology economically achievable." [115]

Effluent Standards—EPA has made substantial progress in developing and promulgating effluent standards. In August 1973, final regulations defining secondary treatment for municipalities were issued, limiting discharge of BOD to a maximum monthly average of



Every "point source" discharger of pollutants must obtain a permit specifying the amount and constituents of his effluent.

30 milligrams per liter and establishing similar limits for suspended solids, fecal coliforms, and pH.[116]

Over the course of the year, EPA also proposed and promulgated a number of effluent limitation guidelines and new source performance standards for a variety of industries. In most cases, these guidelines and standards were based on contract studies, with substantial input from industry, including economic analysis of the impact of the proposed standards on the individual industries.

The task proved to be more complex than was realized when the law was adopted. Whereas the Act lists 27 industrial categories,[117] EPA has identified approximately 180 industrial subcategories and 45 additional variances as requiring distinct effluent standards based on careful analysis of control technology for each. It proved impossible for EPA to complete this volume of analysis within the 1-year period under the law. In November, as the outgrowth of a suit by environmentalists, *Natural Resources Defense Council* v. *Train*,[118]

Table 8

Published Effluent Guidelines

Industry	Proposed	Final (effective date)
Fiberglass	8/22/73	1/22/74
Beet sugar	8/22/73	1/31/74
Cement	7/7/73	1/20/74
Feedlots	9/7/73	2/14/74
Phosphates	9/7/73	2/20/74
Flat glass	10/17/73	2/14/74
Rubber	10/11/73	2/21/74
Ferroalloys	10/18/73	2/22/74
Electroplating	10/5/73	3/8/74
Asbestos	10/30/73	2/26/74
Inorganics	10/11/73	3/12/74
Meats	10/29/73	2/28/74
Plastics and synthetics	10/11/73	4/5/74
Nonferrous metals	11/30/73	4/8/74
Cane sugar	12/7/73	3/20/74
Fruit and vegetables	11/9/73	3/21/74
Grain mills	12/4/73	3/20/74
Soaps and detergents	12/26/73	2/12/74
Fertilizer	4/8/74	7/2/74
Petroleum	12/14/73	5/9/74
Dairy	12/20/73	5/28/74
Leather	12/7/73	4/9/74
Pulp and paper	1/15/74	5/29/74
Organics	12/17/73	4/25/74
Builders paper	1/14/74	5/9/74
Seafood	2/6/74	6/26/74
Timber	1/3/74	4/18/74
Iron and steel	2/19/74	6/28/74
Textiles	2/5/74	7/5/74
Steam and electric power	3/4/74	Not yet published

Source: Environmental Protection Agency.

the U.S. District Court for the District of Columbia established a schedule for the publication of all effluent guidelines between January and November 1974, so that they would be available to "be applied meaningfully" during the permit process. Table 8 lists effluent guidelines published through July 1974. In general, the guidelines for the 1977 period are based on the amount of pollutant reduction attainable through good management and end-of-the-pipe treatment. For 1983, further improvement through process changes is included. In some cases, such as the asbestos millboard and phosphate fertilizer industries, the standards reflect the fact that "no discharge" is attainable.

As discussed in a later section, EPA in July 1973 published a list of 12 toxic pollutants and established effluent limitations for them.

Water Quality Standards—The 1972 Amendments broadened Federal responsibility to all navigable waters and provided that EPA and the states establish water quality standards related to their use. In June 1974, the initial process of reviewing and revising standards was completed. For the period to 1977, the objective of the Act, "to restore and maintain the chemical, physical, and biological integrity of the nation's waters" [119] has been interpreted as requiring standards which will protect indigenous aquatic life and permit secondary contact recreation such as boating and fishing. Water of this quality will generally be sufficient to protect other uses such as public water supply, agricultural and industrial use, and navigation.[120]

These water quality standards are the water quality target for 1977. On the basis of analysis by the states, approximately 1,600, or roughly one-half, of the 3,100 water quality reaches identified will have to go beyond 1977 technology-based effluent standards if these water quality standards are to be met.[121] In some cases, these are segments with a very large discharger or a concentration of dischargers; in other cases, non-point pollution is a major problem. This analysis is one indication of the dimensions of the Nation's water pollution problem.

In October, EPA proposed water quality criteria defining maximum limits of acceptability for chemical and physical constituents in U.S. waters.[122] These criteria are intended to form the scientific basis for any future revision of water quality standards, and in particular the establishment of the 1983 interim goal of providing for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water.[123] Based on recommendations of a National Academy of Sciences report,[124] the criteria reflect current knowledge of the identifiable effects of pollutants on human health, fish and aquatic life, plants, wildlife, shorelines, and recreation; concentration and dispersal of pollutants; and the effects of pollutants on biological community diversity, productivity, and stability, including factors affecting rates of eutrophication and sedimentation. EPA emphasized that decisions on standards and control measures must also consider

the economic and social impact of controlling water pollutants and the practicality and enforceability of the standards and control measures.

The Permit System—The issuance of permits to "point source" dischargers is the law's basic regulatory mechanism. At the same time, it is an enormous and complex task. EPA has received approximately 65,000 permit applications. It expects to receive an additional 10,000 applications from facilities which will fall mostly in the municipal category.[125] Issuance of permits is a central priority in the implementation of the water pollution program, for permits define the requirements and the compliance schedule to be followed by each discharger. The task has additional urgency because after December 1974 the exemption provided in the law, which suspends the provision that discharge of pollutants except in compliance with a permit is unlawful, is no longer in effect.[126]

The law provides that states which meet certain requirements can be authorized to administer the national permit program,[127] and EPA has actively encouraged states to do so. However, a state program must meet a number of requirements,[128] including certain enforcement authority and provision for public participation, and some states have delayed enacting the necessary state legislation. A number of other states have not yet decided that they wish to issue permits. As a result, as of June 30, 1974, only 15 states had assumed responsibility for permit issuance.[129] By December, EPA is hopeful that an additional 10 to 15 states can be granted the authority. Notwithstanding the status of legal authority to issue permits, EPA and the states have been cooperating fully in the permitting task. In some cases, states which possess all the elements of a permit program except the necessary legal authority have been processing permits then issued by EPA.

Given the 65,000 permit applications, EPA and the states have had to establish priorities for processing and issuance. The primary goal is to concentrate on permits which will have the greatest beneficial effect on water quality. The first priority, therefore, is to cover the major dischargers. Approximately 4,600 major dischargers have been identified, of which 60 percent are industrial and 40 percent are municipal. It is planned to issue permits to all these dischargers by June 1975. In total, almost 12,500 permits were issued by EPA and the states by June 1974. An additional 32,000 permits are planned to be issued by June 1975. These issuances will include virtually all municipal and industrial dischargers. Those remaining will be in commercial, governmental, and agricultural areas, vessels, and privately owned treatment plants.[130]

Effluent guidelines and water quality standards are not available to serve as the basis for all permits. Where effluent guidelines have not been published, permits to industrial dischargers are based on the best technical judgment of feasible control technology. Where water

quality standards (or a load allocation based upon them) are not available, effluent guidelines with maximum daily pollutant loads are the basis for the permit.[131]

Municipal Grants—The 1972 Amendments significantly expanded the Federal program for assisting in the construction of municipal treatment plants. The Act established a requirement for universal secondary treatment by 1977, increased the Federal share of treatment grant construction costs to 75 percent, authorized $18 billion in Federal funding over a 3-year period, and established new requirements to be met by industrial dischargers to municipal plants.

Status of Municipal Construction—The status of municipal treatment plant services was summarized in a report issued by EPA in December 1973.[132] This report estimated that of a total population of 210 million, 163 million people were served by sewers in 1973. Secondary treatment was provided to 104 million, and some form of treatment to 159 million. Table 9 shows progress over time.

More disturbingly, the report also showed that as a result of growth, the amount of BOD_5 discharged by municipal treatment plants has remained almost constant since 1957. (Table 10). In that year, 16.4

Table 9

Public Sewerage Services, Selected Years, 1860 to 1973

Year	U.S. population	Unsewered population	Sewered population	Sewage untreated	Sewage treated	Ratio of sewered population to total population	Ratio of treated population to sewered population
		(millions of persons)				(percent)	
1860	31	30	1	1	0	3	0
1870	39	34	5	5	0	13	0
1880	50	40	10	NA	NA	20	NA
1890	63	47	16	NA	NA	25	NA
1900	76	51	25	NA	NA	33	NA
1904	82	54	28	27	1	34	4
1910	92	57	35	31	4	38	11
1915	99	57	42	NA	NA	42	NA
1920	106	58	48	NA	NA	45	NA
1930	123	62	61	NA	NA	50	NA
1932	125	63	62	41	21	50	34
1940	133	66	67	30	37	50	55
1945	140	70	70	28	42	50	60
1948	145	72	73	28	45	50	62
1957	171	73	98	24	74	57	76
1962	186	68	118	17	101	73	86
1968	198	58	140	11	129	71	92
1973	210	47	163	4	159	76	97

NA—not available.

Source: Environmental Protection Agency.

Table 10

Effect of Sanitary Sewage Treatment

[In millions of pounds of BOD_5 per day]

Year	Collected by sanitary sewers [1]	Reduced by treatment [2]	Discharged after treatment
1957	16.4	7.7	8.7
1962	19.8	10.8	9.0
1968	23.3	15.0	8.3
1973	27.1	18.5	8.6

[1] Based on 0.167 pounds of BOD_5 per sewered person per day.
[2] Based on the distribution of treatment facilities and on estimates of removal efficiency.

Source: Environmental Protection Agency.

million pounds of BOD_5 were collected daily by sanitary sewers; of this, 7.7 million pounds were reduced by treatment, and 8.7 million pounds were discharged. By 1973 the amount of BOD_5 collected daily had almost doubled, to 27.1 million pounds, and the amount reduced by treatment had increased by 140 percent, to 18.5 million pounds. Nevertheless, 8.6 million pounds was still discharged daily.

Broader application of secondary treatment over the coming years will reduce these discharges. Secondary treatment, in general, removes about 85 percent of BOD_5. If secondary treatment had been universal in 1973, discharges into receiving waters would have been only 4.1 million pounds per day. This analysis therefore underlines both the impact of growth in generating additional pollutants and the importance of treatment in controlling them.

The Needs Survey—The dimension of the construction program still ahead was indicated by the 1973 Needs Survey submitted to Congress in October 1973. This survey, required by the 1972 Amendments,[183] represented the cost estimates by municipalities for facilities needed to achieve the 1977 secondary treatment standards, to achieve water quality standards, to correct infiltration of groundwater into sewers, and to prevent overflows from combined sewers. The total estimated cost was $60.7 billion. Of this total, $36.6 billion represented the costs of constructing secondary treatment facilities and necessary interceptor sewers—the investments required to meet the 1977 objectives.

The $60.7 billion estimate is far higher than the $18.1 billion originally estimated in EPA's 1971 Needs Survey. The major increase stems from the treatment requirements and eligible facilities added by the 1972 Amendments. Other factors creating the higher estimate are inflation, the addition of communities not previously included, and increased attention to water pollution control at the local level.

In December 1973, the Congress enacted legislation to establish a

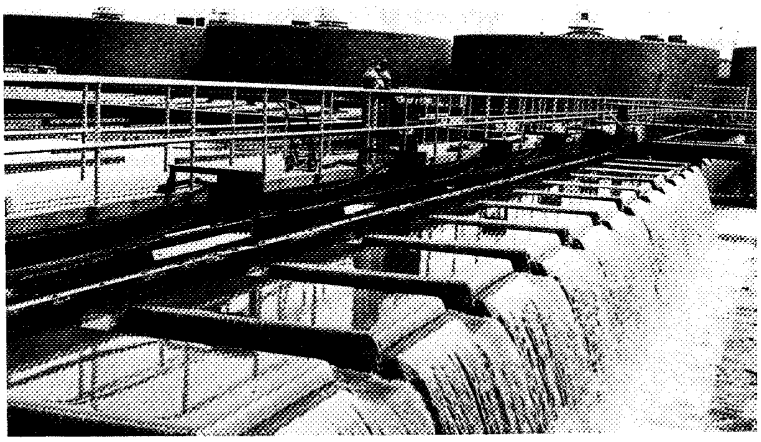
new formula for allocating Federal construction grants among the states.[134] Under the formula, grants are to be based half on the total assessment of all sewage treatment needs and half on the assessment of requirements for secondary treatment and interceptor sewers. The new law directs EPA to develop more specific definitions of eligible costs and requires EPA to conduct a new survey of costs of needed treatment works. The law also permits treatment projects to be funded even if they will not result in a completely operable treatment works without further construction.

Federal Construction Grants—In January 1974, the President directed EPA to make available to the states $4 billion of the $7 billion authorized for FY 1975 in construction grants for sewage treatment facilities. Together with funds made available in previous years, the total provided since the enactment of the 1972 Amendments is $9 billion. The President stated that "competing national priorities for our limited Federal resources" prevented release of the entire amount authorized.[135]

On the grounds that EPA action exceeded the discretion that the Congress gave to the Administrator, several cities, states, and private citizens have filed suits to force allotment of the full amounts authorized. At both the district and appellate levels, courts in different parts of the Nation were divided on the intent of the Act. In April, the Supreme Court granted certiorari to two of these cases. In *New York City* v. *Train*,[136] the Court of Appeals for the District of Columbia ruled that EPA was required to allot the full amount authorized to be appropriated. In *Campaign Clear Water* v. *Train*,[137] the Court of Appeals for the Fourth Circuit held that allotment of funds by EPA was discretionary, subject to judicial review only to determine that allotment was not arbitrary and capricious.

In point of fact, commitment of funds has not to date been much affected by the impoundment because a number of new requirements in the Act, which are discussed below, have had the effect of slowing down obligations. Shortages of some materials such as steel have also hindered progress. During FY 1973, about $1.6 billion in construction grants was awarded. During FY 1974, construction grants totalled $2 billion. For FY 1975, EPA expects that the new procedures will no longer be a major obstacle and has set an objective of obligating $4.1 billion, over twice the amount achieved in FY 1974. Nevertheless, by the end of FY 1975, total Federal obligations will constitute $7.7 billion as compared to the $9 billion made available to the states.

As discussed in last year's Annual Report, the 1972 Amendments contained new requirements to assure that the Nation's investment in new treatment facilities was economically and environmentally sound. The new requirements provide that: (1) alternative techniques for providing municipal treatment, including land treatment, must be considered in the planning process; (2) cost-effectiveness of



Federal grants now cover 75 percent of the cost of wastewater treatment facilities.

treatment facilities must be assured; (3) industrial dischargers to municipal treatment plants must pretreat their wastes so as not to undermine the operations of the treatment plant and must contribute their share of the cost for construction and operation; and (4) waste treatment grants are subject to the provisions of the National Environmental Policy Act, in particular the preparation of impact statements. During the past year, EPA issued regulations and took other actions to further define these requirements and to assist communities in complying with them.

Regulations requiring user charges and cost recovery at federally financed waste treatment facilities were issued by EPA in August 1972.[138] The regulations require all treatment facilities receiving Federal construction grants to recover from industrial users a portion of the construction grant allocable to them. Furthermore, all users—including factories, small businesses, Federal installations and private citizens—are required to pay a user charge, depending upon the expense of the service rendered. The regulations prohibit the practice of giving volume discounts to large industrial customers of treatment plants.

Final pretreatment standards for industrial contributors to publicly owned treatment systems were issued by EPA in November 1973.[139] The purpose of the standards is to prohibit industries from discharging wastes which might cause a fire or explosion or corrosive damage, obstruct the flow in sewers, or upset the treatment process. Specific pretreatment requirements for particular industries are being proposed and promulgated as part of the effluent guidelines. Guidelines to supplement the pretreatment standards had been proposed by EPA in August 1973, to assist municipalities in developing requirements for the pretreatment of industrial waste waters. The guidelines rec-

ommended the joint treatment of industrial and municipal wastewaters where practical, because joint treatment can provide savings in capital and operating expenses, better use of resources, improved operation, and more efficient disposal of sludges.

In July 1973, EPA proposed guidelines for evaluating the cost-effectiveness of sewage treatment facilities.[140] The 1972 Amendments require that a treatment facility have the most economical cost over its estimated life. Any application for a Federal construction grant must include a cost-effectiveness analysis which demonstrates that the proposed facility is the most cost-efficient alternative. The proposed guidelines represented EPA's initial effort to develop standard procedures for cost-effectiveness pursuant to the 1972 Amendments. EPA expects to expand the guidelines in the future to include more detailed procedures and additional guidance on wastewater flow projections, waste treatment management system planning, treatment process selection, and scheduling of construction.

With regard to the preparation of impact statements on wastewater treatment facilities, EPA is seeking to assure proper consideration of environmental impacts while avoiding unnecessary delay. Environmental analysis of the land use impact of sewer construction, discussed in Chapter 1, is of particular importance. Although the number of impact statements prepared to date has been limited, EPA now emphasizes that applicants for grants must prepare complete environmental assessments as integral parts of their plans or applications for grants.[141] At the same time, EPA has taken steps, including preparation of a handbook to assist communities, to assure that the necessary analysis does not delay the grant process.

Non-Point Pollution—A study issued by CEQ this year on the total urban water pollution load gave additional emphasis to the evident importance of non-point pollution. This study, which is described in detail in Chapter 6, showed that stormwater runoff in urban areas carries large volumes of pollutants into receiving waters, with serious impacts on water quality. It also demonstrated that the runoff problem will have to be controlled in many urban areas if water quality standards are to be met. The study recommended analysis and planning to identify the most cost-effective solutions to the runoff problem in each urban area.

The control of non-point pollution is likely to become a major priority for water pollution control in the late 1970's and early 1980's, after pollution from point sources has been alleviated. EPA is taking steps to prepare for this effort. Planning programs authorized by the 1972 Amendments will focus attention on defining the specific nature of the non-point problem on particular water reaches, identifying the sources of the runoff, and developing solutions which will be effective at reasonable cost. At the same time, EPA is supporting research to design better control methods for abating non-point pollution, with

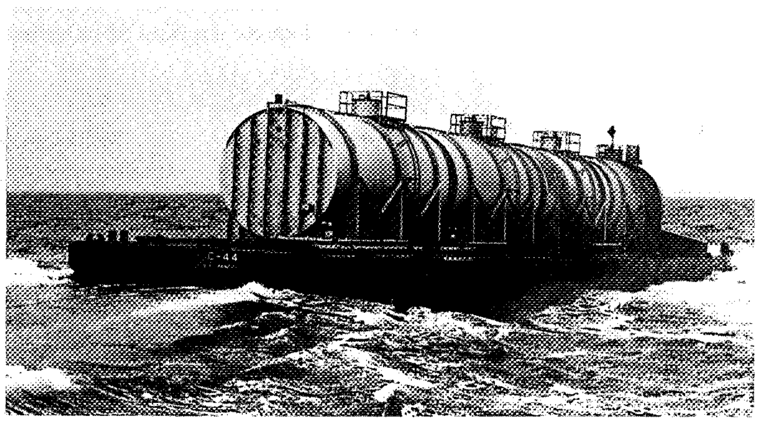
initial attention to runoff from coal mining, agriculture, and construction activities.[142]

Protecting the Oceans

Implementation of the program to control ocean dumping, authorized by the Marine Protection, Research and Sanctuaries Act of 1972,[143] was carried forward over the past year. As described in last year's Annual Report, this law prohibits disposal of radiological, chemical, and biological warfare agents and any high-level radioactive wastes in the ocean and provides for regulation of all other dumping through issuance of permits by EPA or, in the case of dredge spoils, by the Corps of Engineers.

In October 1973, EPA published final regulations governing the conduct of the ocean dumping permit program.[144] Permits, issued for only limited periods, specify the type and amount of material to be disposed of and the location of disposal. Permits are based on criteria which take account of the effects on human health, marine life, and amenities; the permanence and persistence of those effects; and other possible disposal methods. At present, some permits are being issued for wastes which exceed the criteria because there is no feasible alternative means of disposal. In such cases, permit applicants must prepare and carry out a plan which leads to a disposal method complying with the criteria.[145]

Implementation of the permit program resulted in changes in dumping practices. For example, EPA required the city of Philadelphia to move its sludge dump site 36 miles farther out into the Atlantic as an interim measure while it develops an alternative method



Ocean dumping of wastes—in this case acid—is now under regulation and is being phased out.

of disposal. Some 40 dumpers of industrial waste in the New York City area ceased dumping because of regulatory restrictions.[146]

Table 11 shows the wastes (excluding dredged material) disposed of in the Atlantic, Pacific, and Gulf of Mexico during 1973. Over 90 percent of the wastes were sewage sludge or industrial wastes. Over 90 percent of the dumping occurred in the Atlantic.

A critical need is an effective monitoring system to gather data on the effects of dumping on the oceans, so that trends can be detected and actions taken to prevent degradation. EPA, the National Oceanic and Atmospheric Administration, the Corps of Engineers, the Coast Guard, and other Federal and state agencies are cooperating to meet this need.

Safe Drinking Water

The President's Safe Drinking Water Act of 1973 was proposed to assure safe drinking water to protect health.[147] It was based on a strategy which assigned important roles to the Federal Government, state and local governments, and citizens. The Federal Government would develop national health standards for public water supply systems and have authority to intervene in the case of a health emergency. State and local governments would have primary responsibility for implementing and enforcing the standards. Citizens would be informed of any violation of standards and would be authorized to file citizen suits in Federal courts to secure compliance.

In June 1973, the Senate passed drinking water legislation, the Safe Drinking Water Act of 1973.[148] The House has also nearly completed action on its bill.[149] The Congressional legislation is similar to the Administration proposal in most respects but would give the Federal Government broader responsibilities and powers for implementing and enforcing standards. In addition, the House legislation creates a temporary program to assure adequate supplies of chlorine

Table 11

Ocean Disposal of Waste, 1973

[In tons]

Waste type	Atlantic Ocean	Gulf of Mexico	Pacific Ocean	Total
Industrial waste	3,997,100	1,408,000	0	5,405,100
Sewage sludge	5,429,400	0	0	5,429,400
Construction and demolition debris	1,161,000	0	0	1,161,000
Solid waste	0	0	240	240
Explosives	0	0	0	0
Total [1]	**10,587,500**	**1,408,000**	**240**	**11,995,740**

[1] Does not include dredged material.

Source: Environmental Protection Agency.

to disinfect drinking water and treatment plant effluent and provides for the regulation of deep well injection of wastes.

Hazardous Pollutants

Thousands of man-made chemicals are introduced into the environment each year, many for the first time. Of this myriad, a few have potential for causing very serious damage to man or the environment.

The need to regulate hazardous substances was first recognized in 1910 when Congress passed the initial pesticide control law. Since 1910, many laws have dealt with aspects of hazardous pollutant control, including the Occupational Safety and Health Act,[150] the Consumer Product Safety Act,[151] the Food, Drug and Cosmetic Act,[152] the Federal Environmental Pesticide Control Act,[153] the Atomic Energy Act,[154] and the Federal Water Pollution Control Act.[155] But the development and production of potentially hazardous substances continually increases, and serious problems occur which cannot be addressed by existing authority.

This section deals with three different elements of the hazardous pollutants problem—toxic substances, occupational health, and pesticides. Federal authority to regulate each of these is at a different stage of development. The legislative base for control of pesticides has been well established, and relatively mature Federal programs exist to regulate their use. Three and one-half years have passed since the enactment of an occupational health authority, and implementation is in the developmental stage. Urgently needed Federal authority to deal with toxic substances has been proposed by the President but has yet to be enacted by the Congress.

Toxic Substances

The term "toxic substances" applies to chemicals considered threats to man and the environment. As chemical technology develops and expands, additional potentially toxic substances come into use each year. Previous Annual Reports have described environmental health problems from mercury, polychlorinated biphenyls (PCB), haloethers, lead, and cadmium. In 1971—three and one-half years ago—President Nixon proposed the Toxic Substances Control Act [156] to provide authority to regulate toxic substances. Legislation has yet to be enacted, although versions have passed in both the Senate and the House.

The Toxic Substances Control Act would create comprehensive authority to: (1) control the production, distribution, or use of any chemical substance; (2) provide access to information for assessment; and (3) require testing of new chemical compounds or new uses. This legislation would thus provide tools necessary to assess,

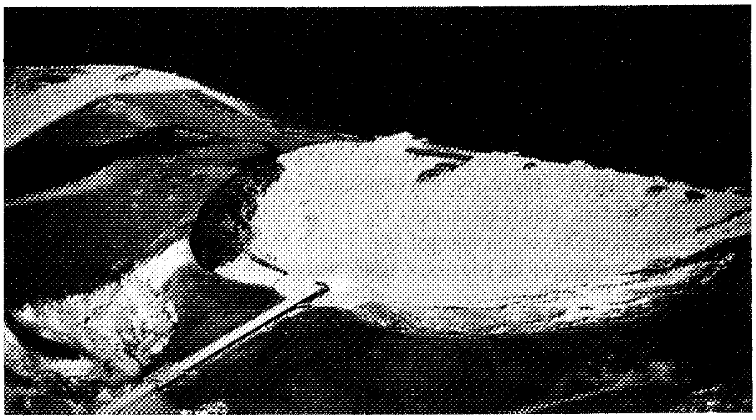
control, and prevent future hazardous pollutant problems and hopefully forestall the necessity for such emergency action as was required in the past year in the case of asbestos and vinyl chloride.

Asbestos—In June 1973, EPA announced the discovery of amosite asbestos fibers in the drinking water of Duluth, Minnesota, and nearby communities. The source of the fibers was traced to the daily discharge of 67,000 tons of geochemically distinct taconite (low-grade iron ore) tailings from the Reserve Mining Company processing plant in Silver Bay, Minnesota.

This discovery resulted in a massive effort of Federal, state, and local agencies to assess the potential threat to health. The Chairman of the Council on Environmental Quality was given responsibility to coordinate Federal activities relating to the problem.

The full implications to health of this asbestos cannot as yet be defined with certainty. Fibers averaging less than 2 microns in length were found in concentrations ranging up to 100 million fibers per liter in tap water in Duluth and nearby communities. Hence over 200,000 people have ingested considerable amounts of asbestos over the 18 years since the plant started production. Furthermore, levels of asbestos in the air near the plant in Silver Bay range from about 100,000 to 10 million fibers per cubic meter. The primary health concern is that asbestos, a carcinogen which causes a variety of cancers (including gastrointestinal cancer) when inhaled, will also cause cancer when ingested. Epidemiological and clinical studies of the Duluth population cannot provide a clear answer because the average period from initial exposure to the first symptoms of asbestos-induced cancer is 20 to 40 years. Yet when sufficient time has lapsed to make definitive conclusions, the fate of those who have drunk the contaminated water over the past 18 years may have been sealed.

The original suit was filed in February 1972 against the Reserve



Reserve Mining discharges 67,000 tons of taconite, containing asbestos, into Lake Superior every day.

Mining Company by the United States Government on the grounds that Reserve was in violation of the Federal Water Pollution Control Act and the Refuse Act and was causing ecological damage to Lake Superior. When asbestos was discovered in the Duluth water supply, the suit was amended to include public health issues. After the original suit was filed, the parent corporations of Reserve Mining Company (Armco Steel Corporation and Republic Steel Corporation) and several north-shore communities and business entities were joined as defendants. Plaintiffs now include three states,[157] five environmental organizations[158] and the cities of Duluth, Minnesota, and Superior, Wisconsin.

On April 20, 1974, Judge Miles Lord of the U.S. District Court in Minneapolis shut down the Reserve plant, basing his decision upon the finding of an existing health hazard. A temporary stay of the order was obtained by Reserve from the Eighth Circuit U.S. Court of Appeals on April 22. A second Court of Appeals decision on June 4 extended the stay an additional 70 days, conditioned on good faith preparation and implementation by Reserve of an acceptable on-land disposal plan. The U.S. Supreme Court declined to set aside the Circuit Court decision.

Because communities located on the north shore draw their water supplies from Lake Superior, Chairman Peterson wrote the governors of Minnesota, Wisconsin, and Michigan in February, recommending that all affected communities take necessary steps to provide adequate filtration for their drinking water supply. A joint EPA and Corps of Engineers research pilot treatment study was initiated at that time. On April 5, the Chief of the Corps of Engineers, using a newly enacted authority,[159] announced a program to supply micropore filter units for the water taps of public buildings in each of the affected communities so that all citizens could avail themselves of fiber-free water, and to provide interim water supply treatment measures within 4 to 6 months until permanent water supply treatment facilities were completed.

Vinyl Chloride—On January 22, 1974, the National Institute of Occupational Safety and Health announced that the B. F. Goodrich Company had found that the death of three of its workers from previously rare liver cancer (angiosarcoma) was related to occupational exposure to vinyl chloride. This announcement caused immediate concern. Approximately 5.2 billion pounds of vinyl chloride gas were produced in 1972 at over 16 locations in the United States. Approximately 97 percent of this production was used at 40 plants to produce polyvinyl chloride (PVC), which was then converted at a vast number of sites to polyvinyl chloride plastic products. The other 3 percent of vinyl chloride was used for a wide variety of purposes such as the propellant gas for a number of aerosol cosmetics and pesticides.

Since January, 16 additional cases of angiosarcoma of the liver from occupational exposure to vinyl chloride have been identified.[160]

More cases are suspected and are being investigated. Animal toxicity tests on mice and rats seem to confirm that vinyl chloride produces angiosarcoma of the liver at levels at least as low as 50 parts per million. Preliminary medical studies of workers exposed to this chemical also reveal abnormally high levels of other liver and kidney disorders and cancer of other organs.

Because of the large number of workers who have been involved with vinyl chloride over the last 15 years and because the general population has also been exposed to some degree, the 19 reported cases may be merely the first indication of a much larger environmental and occupational health problem, particularly since 15 years is less than the normal period of time required for cancer symptoms to develop.

Rapid action has been taken since January to assess and deal with the problem. On April 5, the Occupational Safety and Health Administration (OSHA) issued a temporary emergency standard of 50 parts per million as the maximum allowable limit of exposure to workers.[161] On April 22, the Food and Drug Administration proposed banning vinyl chloride as a propellant and ingredient in aerosols.[162] On April 26, EPA suspended the registration and sale of all pesticides containing vinyl chloride designated for indoor use.[163] On May 9, the Consumer Product Safety Commission required disclosure by producers of the use of vinyl chloride in all aerosol consumer products.[164] On May 10, OSHA proposed a permanent workplace standard of no detectable exposure, using equipment sensitive to one part per million.[165]

Although the production and use of plastics made from PVC resins are not known to create health problems, investigations are underway, particularly of uses in food and beverage processing. Air and water pollution control requirements at plants producing PVC are also under consideration.

Toxic Water Pollutants—The 1972 Amendments to the Federal Water Pollution Control Act [166] define toxic pollutants as those pollutants which "cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such organisms or their offspring." In July 1973, EPA designated 12 chemicals used in manufacturing as toxic water pollutants,[167] including the pesticides aldrin, dieldrin, endrin, DDT and its derivatives DDE and DDD; the pesticide compound toxaphene; cadmium, mercury and cyanide; and the industrial chemicals benzidine and PCB (polychlorinated biphenyls). These pollutants are toxic in very low concentrations, with the exception of benzidine, which was included because of its ubiquity and known carcinogenic properties. EPA is currently developing effluent standards governing the discharge of these toxic pollutants.

EPA is currently studying arsenic, selenium, chromium, lead, as-

bestos, sevin, zinc, chlordane, lindane, acridine, hydroquinone, orthochlorophenol, beta-naphthol, alpha-naphthol, beryllium, nickel, antimony, heptachlor, camphor, methyl parathion, parathion, and di-n-butyl phthalate for possible inclusion on the list.

Lead—It has been estimated that over 500,000 persons under 18 have concentrations of lead in their blood of 40 micrograms per 100 grams.[168] Important biochemical changes are known to occur in children with blood lead levels in the range of 40 to 60 micrograms per 100 grams.

These concentrations of lead are believed to come predominantly from environmental sources, including lead in old house paint and putty, and combustion of lead in fuels. Although the major source of high lead concentrations in the blood level of children is undoubtedly ingested lead paint, the fact that a sufficient fraction of children with high lead levels in their blood live in nondilapidated housing implies that lead in gasoline reaches children either through inhalation of atmospheric particulates or through ingestion of house dust and dirt.

On December 6, 1973,[169] EPA promulgated regulations limiting the lead content of gasoline. This limitation reduced the allowable level of lead to an average of 1.7 grams of lead per gallon in 1975 and 0.5 grams of lead per gallon in 1979. The regulation was based in part upon the need for non-leaded gas to avoid poisoning air

EPA regulations will limit the amount of lead in gasoline, the most significant source of lead exposure.

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pollution catalysts (as described earlier in the chapter), but it will also reduce the introduction of lead into the environment from the combustion of gasoline, which is the most significant and controllable source of lead exposure.

Hexachlorobenzene—In 1955, Turkey suffered an epidemic of what was called "monkey face" disease which affected up to 5,000 persons. The symptoms of the disease included enlarged livers, abnormal sensitivity to light, weight loss, and abnormal hair growth (particularly on the face). The cause of the disease was traced to the consumption of seed grain treated with a fungicide called hexachlorobenzene (HCB).

In December 1972, the U.S. Department of Agriculture identified HCB levels above 0.3 ppm in beef carcasses while taking routine fat samples for pesticide analysis. Over 20,000 animals were quarantined. More recently, HCB residues have been detected in slaughtered animals in California and Texas.[170]

Hexachlorobenzene is a stable persistent chemical with relatively low acute toxicity. But it causes serious delayed effects such as enlarged livers and even death in rats at daily doses of as little as 30 mg/day HCB in food.[171]

Most HCB is used as a fungicide for treating seed grains. However, known cases of food contamination by the chemical to date have not been linked to this use. Rather, contamination from HCB may result from the fact that HCB is an impurity of up to 10 percent in other pesticides, from air and water contamination during HCB manufacture, and from landfill disposal of HCB residues produced during manufacture of perchlorethylene and tetrachloride.

On July 1, 1973, the Environmental Protection Agency set an interim level of 0.5 ppm in the fat of animals at the time of slaughter.[172] This guideline is reviewed every 90 days and is still in effect. EPA is continuing research on air-related sources of HCB, toxicological effects in animals, and decomposition of HCB in the soil.

Occupational Health

The workplace is the portion of man's environment in which problems with hazardous substances are often first apparent and in which their health impact is often most severe. In 1973, the U.S. workforce of over 88 million workers suffered over 250 million days [173] of lost work due to workplace conditions. Significant lost productivity results from known occupational diseases. Undoubtedly, more occupational disease exists than is recognized.

In 1970 the Occupational Safety and Health Act was enacted,[174] giving the Occupational Safety and Health Administration (OSHA) within the Department of Labor authority to establish and enforce standards, to provide training and educational programs, and to set

up an injury and illness reporting system. The Act also empowers the National Institute for Occupational Safety and Health (NIOSH) under the Department of Health, Education, and Welfare to conduct research and make recommendations for standards to OSHA.

The Act provides for state implementation upon request of the governor and the finding by OSHA that the standards and enforcement proposed are at least as effective as Federal implementation. To date 25 states have received approval to administer their own programs. However, in a class action suit, AFL–CIO is challenging these approvals on the grounds that state implementation will not be equivalent to Federal enforcement.[175]

The Occupational Safety and Health Act provided for the establishment of three types of standards. Initially, OSHA was empowered under Section 6(a) of the Act (until April 1973) to establish national consensus standards. Such consensus standards were established for approximately 400 chemicals. As intended by the Act, these standards were based on guidelines and practices which had previously been set by industry and government agencies. They consisted primarily of threshold limit values (the limits for the concentration of the chemical in the air).

Section 6(b) provides authority and procedures for promulgating "permanent" standards whenever the Secretary of Labor determines that such a standard should be issued. The "permanent" standard may include requirements regarding work practices, monitoring, and medical surveillance in addition to threshold limit values.

NIOSH has authority to carry out clinical and field research and make recommendations for standards, transmitting the recommendations to OSHA in the form of criteria documents.

Since passage of the Act in 1970, only 16 criteria documents have been transmitted by NIOSH to OSHA. These criteria documents are recommendations. To date, only one standard—for asbestos—has been promulgated by OSHA based on a criteria document. In addition, standards have been set for 14 carcinogenic substances.

Section 6(c) provides for the establishment of temporary emergency standards. These are effective for only 6 months. Temporary emergency standards are designed to provide interim protection while OSHA develops a "permanent" standard. Most recently, OSHA has promulgated emergency standards for vinyl chloride and pesticide field reentry intervals.

Asbestos—The first comprehensive OSHA standard, asbestos, was established in December 1971.[176] Designed to prevent a severe respiratory impairment called asbestosis, the standard set a level of 2 fibers (of 5 microns in length) per cubic centimeter of air in the workplace. This standard also contains provisions for work practices and personal and environmental monitoring. It will go into effect July 1, 1976. An interim requirement of 5 fibers per cubic centimeter is in effect until then.

The standard was challenged in the courts by the AFL–CIO and the Environmental Defense Fund on the grounds that workers would not be free of risk, particularly from cancer, and that provisions for monitoring, labeling, recordkeeping, minimum concentrations, and control methods are inadequate. In April, the court upheld the standards, requiring OSHA only to reexamine the uniform application of the 1976 effective date for the 2-fiber standard and requiring employers to keep monitoring records for a period of 3 years.[177]

Because the standard was not originally designed to protect against mesothioloma, a family of diffuse cancers known to occur on exposure only to asbestos-like fibers, the standard is currently undergoing thorough review by OSHA.

Carcinogens—In January 1973, the Health Research Group and the Oil, Chemical and Atomic Workers Union requested a temporary emergency standard to prevent worker exposure to 10 cancer-causing chemicals. In May 1973, OSHA took emergency action to establish a temporary emergency standard to prevent worker exposure to 14 carcinogens. This standard mandated specific work practices to be followed in a plant.[178]

In September 1973, the OSHA Advisory Committee on Carcinogens [179] recommended the establishment of a permit system with specified monitoring requirements to guarantee that workers not be exposed to measurable levels of the 14 chemicals.

In January, after a 2-month lapse of the temporary emergency standard and after having circulated a revised environmental impact statement, OSHA promulgated 14 separate standards [180] covering the 14 carcinogens. Each standard consisted primarily of required practices to be followed in a plant; no permit system was established and no monitoring was required.

The 14 standards have been challenged in the U.S. Court of Appeals by the Health Research Group and the Oil, Chemical and Atomic Workers Union on the grounds that the standards failed to adopt performance standards of zero detectable exposure, implement the use permit system, require personal and environmental monitoring, and require medical surveillance specific to exposure to the particular carcinogen.[181] Suits have also been filed by industries [182] on the grounds that four of the substances [183] are not carcinogenic.

Pesticide Field Reentry—Authority to regulate field worker exposure to pesticides is provided in both the Occupational Safety and Health Act and the Federal Environmental Pesticide Control Act (FEPCA). The former protects employees and the latter directs EPA to control the use of pesticides.

In May 1973, the Department of Labor issued temporary emergency field reentry standards to protect farm workers from exposure to hazardous pesticides.[184] In his 1972 Environmental Message the President had ordered development of standards to define the time

following application of pesticide during which laborers may not enter the fields. Reentry times of up to 30 days were established for 21 pesticides used on 6 crops. These temporary emergency standards lapsed in November 1973.

In May 1974, the EPA promulgated permanent field reentry standards.[185] These standards provide a requirement that unprotected workers be prevented from entering pesticide-treated fields until the sprays have dried or dust settled. Reentry times of 24 to 48 hours were established for 12 highly toxic pesticides.

Pesticides

Pesticides and various other chemicals used for agricultural or horticultural purposes are presently controlled under the Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (FIFRA)[186] as amended by the Federal Environmental Pesticide Control Act of 1972 (FEPCA). FEPCA expanded provisions of the 1947 Act, giving EPA new authority to classify chemicals for restricted use, to regulate the use of products in addition to specifying labeling, and to control products sold in interstate commerce. FEPCA provisions take effect over a 4-year period; corresponding provisions of FIFRA remain in effect until they are replaced.

Implementation of FIFRA, as Amended—In October 1973,[187] EPA proposed regulations requiring all producers of pesticides to maintain records showing the brand name, type, amount, and composition of every batch of pesticide produced, and the receipt and shipment of all pesticide, with authorization for EPA to inspect and copy these records. Subsequently, in November 1973, EPA issued final regulations for registration, labeling, and reporting of pesticide production.[188] All establishments in which pesticides are produced must register with EPA and must submit reports on production, sales, and distribution. Under the regulations, establishments in interstate commerce had to submit applications for registration by December 4, 1973; establishments producing solely for intrastate commerce did not need to submit applications until October 1974. All pesticide products released for shipment on or after October 21, 1974 by all interstate establishments must bear an EPA establishment registration number. Products released for shipment by intrastate establishments must display the establishment registration number 6 months after such establishments are notified of registration. New products are required to bear an EPA registration number from the outset of production.

To provide for certain emergency situations in which a registered pesticide may not be available or effective, EPA in December 1973 issued final regulations governing the emergency use of unregistered pesticides.[189] Under these regulations, toxaphene has been used on

sod webworm in South Dakota because the registered pesticide parathion was not available.

FIFRA as amended is intended to foster research and development of new pesticides by assuring some protection of an investment made by a developer in procuring data in support of registration for a new chemical. EPA plans to provide reasonable protection and compensation for the production of data on a new pesticide, while at the same time assuring that competition is not unduly affected and that available knowledge of pesticides is not restricted, to the detriment of the public interest. Accordingly, the law requires that an applicant for a pesticide registration who makes use of test data developed by a previous applicant must pay for this use after October 1974.

Regulatory Actions—Under both FEPCA and FIFRA, EPA has authority to control the registration of various chemical pesticides. Under the law, any total or partial ban of individual pesticides or chemicals must not cause undue risk to the public health and welfare. Public hearings to acquire data and develop knowledge about various chemical substances have been held by EPA throughout the year.

Aldrin and Dieldrin—In March 1971, EPA issued a notice of intent to cancel all Federal registrations of products containing aldrin and dieldrin.[190] Following a 1972 scientific advisory committee review, EPA ordered retention of the two pesticides for termite control, nursery dipping of roots and tops of nonfood plants, and mothproofing of woolen textiles and carpets where there is no effluent discharge. Shell Chemical Company, the sole manufacturer of aldrin/dieldrin, has voluntarily withdrawn a number of the more controversial registered uses, including those for aerial application, dust formulations, fire ant control, and granules for termite control.

The continued use of aldrin and dieldrin for the protection of corn, citrus, and certain other crops is being examined by EPA at hearings which began in October 1973. EPA is considering cancelling all or part of the Federal registrations of the two pesticides for control of soil insects attacking corn and citrus fruit, for orchard trunk spraying, and for foliage application on certain fruits and vegetables. The economic and social benefits derived from use of the two pesticides and the establishment of acceptable residue tolerances for these chemicals in meat, milk, eggs, and certain other food commodities have been discussed at the hearings.

In August, EPA announced its intent to suspend all uses of aldrin and dieldrin pesticide products. A suspension order halts sales and uses of a product pending the final outcome of the cancellation process. Subject to reconsideration by the Administrator after public hearings, a final suspension decision could be made as early as September.

In March 1974, a routine survey by the U.S. Department of Agri-

culture showed chickens in the area of Jackson, Mississippi, with residues of up to 15 parts per million of dieldrin. After an investigation by EPA, over 8.5 million birds with residues in excess of 0.3 parts per million had to be sacrificed. The source of contamination has been traced to oils used in the preparation of chicken feed.

2,4,5-T—EPA planned to hold a public hearing on federally approved uses of 2,4,5-T to examine whether to change the registration of this chemical for uses such as clearing brush from range, pasture, forest land, and utility and highway rights of way, and for weed control in rice fields. The major concerns in the registration of 2,4,5-T are potential health hazards to man and animals, possible bioaccumulation in the environment and animal tissues, availability and possible adverse environmental effects of alternative control methods, actual effectiveness and cost of 2,4,5-T, and importance of toxic impurities.

On June 28, 1974, EPA withdrew its Notice of Intent to Cancel 2,4,5-T as it relates to rice, and dismissed the public hearings on all registered uses of herbicides derived from 2,4,5-T.[191] EPA took this action because of methodological problems in the monitoring of tetrachlorodioxin (TCDD), a contaminant of 2,4,5-T.

Mirex—EPA is currently holding hearings on whether to amend or cancel the registration of Mirex, a chemical used to control the fire ant in the southeastern states and to prevent mealy bug wilt on pineapples in Hawaii. Although the fire ant does little direct damage to crops, its sting can be painful and cause illness. In certain types of soils, mounds built by the ant can complicate operations of farm machinery. Major issues covered at the hearings include the persistence, mobility, and possible biological concentrations of Mirex; hazards to man and the environment, with emphasis on aquatic life; the extent of human health problems caused by the fire ant; the economic impact of the pest on agriculture; and the availability of alternative control measures.

EPA is also reviewing the use of certain rodenticides in field, home, or urban areas. The products being investigated contain calcium cyanide, strychnine, sodium monofluoroacetate, and sodium cyanides.

DDT—In June 1972, EPA issued an order [192] prohibiting major uses of DDT, which had been found to seriously damage birds, fish, and other organisms in the food chain. The ban was challenged pursuant to FIFRA in the U.S. Court of Appeals for the District of Columbia [193] by both environmental groups and DDT manufacturers.

The Environmental Defense Fund, the National Audubon Society, the Sierra Club, and the West Michigan Environmental Action Council charged that EPA should ban all uses of DDT, rather than permit its limited use for public health and agricultural quarantine

purposes. Coahoma Chemical Company alleged that EPA went too far in cancelling registrations for most agricultural uses of DDT. The court upheld EPA's ban on uses of DDT.

In response to a request from the U.S. Forest Service, EPA in January 1974 granted restricted authority for the use of DDT to control the tussock moth on 650,000 acres of forest land in Washington, Oregon, and Idaho. The tussock moth is a native forest pest whose population fluctuates cyclically. Usually viruses build up over a 3-year period during a moth outbreak. If the virus concentration is sufficient, the disease will keep the moth population in check. EPA's approval was based upon a determination that virus concentrations were too low to prevent unacceptable levels of forest damage and that no alternative control measures to DDT were as yet sufficiently developed. The Forest Service use of DDT will be restricted to one season and to only those areas where absolutely necessary.

Radiation

Exposure Standards

Last year's Annual Report described the results of a major review by the National Academy of Sciences of the effects of ionizing radiation on man.[194] The study estimated the average annual whole-body exposure of the U.S. population from all sources of radiation. Of the total annual exposure of 182 millirems, 102 millirems was found to come from natural background sources, 73 millirems from medical exposures, 4 millirems from global fallout, and a small fraction of 1 millirem from nuclear power. The NAS study compared the expected exposure to radiation from man-made sources (other than medical) with the current EPA exposure guide of 170 millirems per year. Recognizing that the exposure guide was based on an effort to balance societal needs against genetic risks, the NAS study concluded that "it appears that these needs can be met with far lower average exposures" and thus that "the current guide is unnecessarily high." [195]

In the fall of 1973, the Office of Management and Budget [196] clarified the roles of the Atomic Energy Commission (AEC) and the Environmental Protection Agency (EPA), as set forth in the President's Reorganization Plan No. 3 of 1970,[197] with respect to setting standards and guidance for radiation exposures. The EPA is responsible for issuing generally applicable environmental standards for the protection of the environment from all sources of radiation, including generally applicable ambient standards for the total amount of radiation in the general environment from all facilities in the uranium fuel cycle. The AEC is responsible for developing, implementing, and enforcing generally applicable standards for individual nuclear facilities, which will limit the amount of radioactive material released in effluents during the normal operation of these facilities to levels as

Limited use of DDT to control the tussock moth in the Northwest was authorized by EPA in January.

low as practicable. By this is meant levels as low as are readily achievable, taking into account social and economic costs.

In February 1974, EPA published a report explaining the "environmental dose commitment" approach which it would follow in establishing radiation protection standards.[198] The report distinguished between the short-lived and long-lived radionuclides produced by nuclear facilities. The short-lived nuclides decay soon after their release to the environment, and consequently their contribution to overall population exposure is of short duration. On the other hand, long-lived nuclides are persistent in the environment and therefore can be considered relatively permanent pollutants. Control of such persistent radioactive materials is particularly important in view of the expected growth in the nuclear industry.

The report considers the dispersion of long-lived radioactive material into the future. Buildup of radioactive material in the environment is a factor to be considered in regulation and rulemaking actions for the nuclear industry. Furthermore the report indicates that the overall environmental impact caused by the release of long-lived radioactive materials in normal operation of the nuclear power industry can be relatively small, provided that proper controls are maintained.

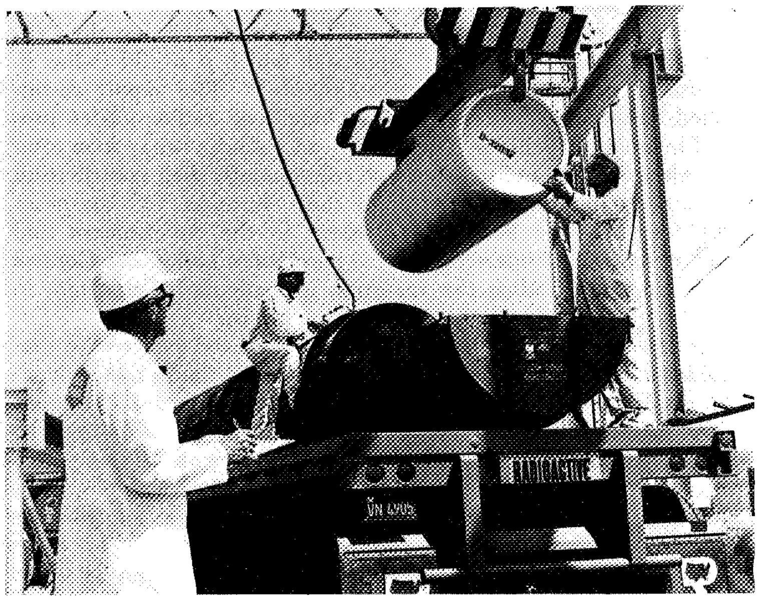
In accordance with the division of responsibility between EPA and the AEC, EPA in May announced its intention to issue applicable environmental standards to protect the public from exposure from

normal operations of the uranium fuel cycle,[199] including all facilities or operations involved in the processing, fissioning, and reprocessing of uranium for light-water reactors. Simultaneously, AEC stated its intention to consider rulemaking to provide specific design and operating guidance on "low as practicable" emissions for these same facilities. EPA indicated that it would seek to strike a balance between limiting to the lowest feasible levels the public health and environmental impact of radiation emissions and maintaining the benefits to society's health and welfare of uninterrupted electric power.

Nuclear Accident Evaluation

With regard to the safety of nuclear reactors, AEC policy seeks to assure that the probability of an accident and the potential exposure of persons if an accident did occur are as low as is practicably achievable. AEC implements this policy through stringent standards for plant design, construction, and operations, and through engineered safety features to accommodate any failures of equipment or operators.

Before obtaining a license from the AEC, applicants are required to evaluate the potential environmental impact of a spectrum of accidents at their proposed plants. These hypothetical accidents vary in their probability and in their potential consequences, and include sequences of successive failures whose consequences could be severe.



Safeguarding of highly enriched uranium emerged as an issue this past year.

Because of strict regulation, the potential for accidents in this class is judged to be sufficiently small that the environmental risk is extremely low.

In August 1974 the AEC released for public comment the results of a reactor safety study done for the agency by a group of some 50 specialists under the direction of Professor Norman Rasmussen of the Massachusetts Institute of Technology. The study undertook to develop data on sequences of accidents and on the probability and consequences of accidents in water-cooled nuclear power reactors. It assessed reactor accidents as compared to non-nuclear accidents such as fires, explosions, releases of toxic chemicals, dam failures, earthquakes, and hurricanes. Findings indicated that the non-nuclear accidents to which society is already explosed are about 10,000 times more likely to produce large numbers of injuries to people than accidents involving nuclear plants. The study concluded that "the risks to the public associated with nuclear power are very small, and that the likelihood of reactor accidents is much smaller than many types of non-nuclear accidents with similar consequences."

The AEC is conducting an extensive review of the report, *Reactor Safety Study: An Assessment of of Accident Risks in U.S. Commercial Nuclear Power Plants,* and is receiving comments from the public. The final version of the report will be issued in 1975.

Nuclear Fuel Safeguards

While most of the reactors in the nuclear industry do not today use highly enriched uranium, there will be an increase in such material, along with plutonium, over the next 10 to 20 years. These types of nuclear fuels will be produced, processed, transported, and handled by private sector firms. Special nuclear materials, particularly plutonium, can be made into explosive devices if sufficient skill and resources are available. Further, if a few grams of plutonium could be dispersed as a finely divided powder, it would present a gravely serious health hazard in the form of widespread radioactive contamination. As a result of these potential dangers, the problem of safeguarding special nuclear materials received increased attention over the past year.

A study for the Ford Energy Project, *Nuclear Theft: Risks and Safeguards,* stated that the necessary information to construct a nuclear explosive device is available in public literature.[200] In the view of the AEC, the simplicity of building a nuclear explosive has been misrepresented. The skills necessary to assemble suitable material for a nuclear explosive device are not simple or commonly available. In particular, the hazards of an effort to build a nuclear device would be extreme and the chances of self-destruction fairly high. On the other hand, construction of a device to disperse plutonium powder would be significantly simpler but would represent a much smaller, though highly serious, health threat.

There is no disagreement, however, that safeguards to protect these materials are essential. The Energy Project study concluded that effective safeguard systems can be devised to reduce the risks of diversion to levels that society will be willing to tolerate.

The AEC presently has in operation, in the case of significant quantities of enriched uranium and plutonium, a wide range of safeguards deemed sufficient to protect these materials in transit or in storage. The increasing recovery of plutonium from reactor fuels will require the application of the same safeguards now afforded to weapons materials. The AEC also has an active research and development and standards program to develop improved protective procedures for the future. Hence, while the implications of diverting nuclear materials are alarming, improved protection for these materials is now being afforded; and, as new research developments emerge, they will be employed in achieving higher levels of control.

Nuclear Wastes

The management and disposal of nuclear wastes is another problem associated with nuclear power that has attracted attention in the past year. As nuclear fission becomes a major source of energy in the future, large quantities of radioactive wastes will be generated. Much of this waste will have to be effectively isolated from the environment for very long periods of time—as long as a half-million years in the case of plutonium.

The AEC has proposed that high-level radioactive wastes be deposited for an interim period in a Retrievable Surface Storage Facility (RSSF), pending the development of a suitable method of permanent storage. Radioactive waste designated as "other-than-high-level" would be buried in authorized burial grounds. The environmental implications of the interim storage proposal were discussed in AEC's draft environmental impact statement on the Liquid Metal Fast Breeder Reactor program. Some comments on the statement were critical of the RSSF proposal as being of unproven reliability, security, and cost-effectiveness. The AEC has announced that a statement is being prepared on the proposal to construct the RSSF.

A study of possible solutions to the permanent storage of long-lived radioactive wastes was conducted for the AEC by the Battelle Pacific Northwest Laboratory during the past year.[201] Completed in May 1974, the comprehensive study analyzes several methods of disposing of long-lived nuclear wastes, including storage in various geologic formations on land, in the seabed, and in ice sheets; disposal in outer space; and elimination by transmutation (nuclear transformation into a less harmful substance). Although the study did not endorse any method, it did examine the relative advantages and disadvantages of each scheme with respect to technical feasibility, development time, costs, and environmental impact. Several of the

proposed methods appear to be practical if the associated environmental impacts can be minimized.

Noise

The Noise Control Act of 1972 makes the Federal Government responsible for regulation of noise emissions from a broad range of sources.[202] Over the past year, the Environmental Protection Agency and the Department of Transportation have taken steps to implement that law.

Aircraft Noise

Under the Noise Control Act, EPA was directed to study and report to Congress on the aircraft and airport noise problem, including assessment of: (1) current FAA flight and operational noise controls, noise emission controls, and possibilities for retrofitting or phasing out existing aircraft; (2) control measures available to airport operators and local governments; and (3) implications of establishing cumulative noise level limits around airports. In July 1973, EPA submitted its report.[203]

The report estimated that 16 million people are presently exposed to aircraft noise levels with effects ranging from moderate to very severe. Although some noise reduction has been accomplished, EPA concluded that ". . . it appears that existing FAA flight and operational controls do not adequately protect the public health and welfare from aircraft noise."[204]

The report identified a number of ways by which present noise

Sixteen million Americans are exposed to aircraft noise levels with effects ranging from moderate to very severe.

levels could be reduced. Although only 10 percent of the existing fleet of 2,000 commercial aircraft now meet the Federal Aviation Agency (FAA) noise regulations applicable to new aircraft, retrofit with currently available technology—in particular, nacelle acoustical treatment—could permit existing aircraft to meet this level. Furthermore, technology is available to permit even lower noise emissions from new aircraft. With respect to airport operations, broader use of a variety of flight procedures now practiced at certain airports around the country could further reduce noise exposure.

The costs of controlling aircraft and airport noise were estimated to range from under $1 billion to over $20 billion, depending on what level of control and what control measures are chosen. The least costly approach would involve modification of flight procedures and retrofit of some existing aircraft. Additional control measures—more extensive retrofit of existing aircraft, lower noise standards for new aircraft, installation of soundproofing in residences and other buildings, and conversion of land surrounding airports from residential to less noise-sensitive uses—would involve additional costs.

The report also recommended that aircraft noise near airports be measured on a cumulative basis, with nighttime exposure given greater weight than daytime exposure. EPA has developed a method for measuring noise in this way.

The Noise Control Act required EPA, at the conclusion of its study, to propose to the FAA any regulations judged necessary to protect public health and welfare. Accordingly, in February 1974, EPA invited the public to participate in drafting 10 such regulations.[205] These regulations will have three major objectives: to make aircraft inherently quieter and to have them flown as quietly as possible; to modify operations at airports to minimize the noise impact zone and tailor its shape to avoid noise-sensitive land uses such as housing, schools, and hospitals; and to prevent buildup of noise-sensitive land uses in noise impact zones and, where necessary, use soundproofing and land conversion where exposure cannot be decreased by other means. EPA expects to complete the 10 regulations over the period from August 1974 to April 1975.

Under the Noise Control Act, regulations developed by EPA must be submitted to the FAA, which is required to hold public hearings on them. The Act establishes an elaborate procedure for public communication between EPA and FAA that is designed to resolve any major disagreements. Under the law, however, the final decision to modify or adopt new regulations for the control of aviation noise is the responsibility of FAA.

There were other developments with respect to aircraft noise over the past year. FAA took several actions. In October 1973, the FAA proposed the first noise standards for small propeller aircraft and also extended the commercial jet aircraft standards to cover new production of older aircraft models such as the Boeing 707 and DC–8.[206] In December, FAA announced its intention to regulate noise

from new short haul aircraft with VTOL (vertical take-off and landing) and STOL (short take-off and landing) capabilities.[207]

In February 1974, the Environmental Defense Fund and the National Organization to Assure a Sound-Controlled Environment filed suit against FAA to require issuance of noise regulations for supersonic transport aircraft no less stringent than current regulations for subsonic aircraft.[208] If such regulations are adopted, they would effectively prohibit flight of the British-French Concorde and Soviet TU–1444 over U.S. territory.

Surface Transportation Noise

The Noise Control Act requires EPA to regulate noise emissions from motor carriers and railroads engaged in interstate commerce. In July 1973, EPA proposed regulations to establish noise limits for medium and heavy-duty trucks of over 10,000 pounds.[209] In most cases, the proposed standards can be met by trucks with functioning mufflers. For an estimated 190,000 trucks, minor adjustments costing between $50 and $200 per vehicle may be required. The regulations also establish a maximum noise level of 90 decibels for trucks travelling over 35 miles per hour on any surface. Most trucks will not be able to comply with this standard unless tires with low noise levels are installed.

In July, EPA proposed regulations to reduce noise from railroad trains.[210] Within 4 years after promulgation, these regulations would require the installation on diesel electric locomotives of mufflers representing the best available technology at reasonable cost. EPA estimates that the cost for retrofitting the 27,000 existing locomotives would be $80 to $100 million. Within 9 months of promulgation, these regulations would require improved maintenance to reduce noise, including the elimination of excessive flat spots on wheels and proper maintenance of locomotives.

In February 1973, under the Federal-Aid Highway Act, the Federal Highway Administration (FHWA) issued noise standards and procedures to be used in planning and design of highways.[211] Design noise level standards were set at 60 dBA for tracts of land in which serenity and quiet are of extraordinary significance and serve an important public need; 70 dBA for the exterior of facilities such as residences, motels, public meeting rooms, schools, and hospitals; 75 dBA for other developed lands not included in the previous two categories; and 55 dBA for the interior of various facilities, including residences, motels, public meeting rooms, schools and hospitals. Henceforth all federally aided highway projects must provide for noise abatement measures such as barriers where required to meet these standards. In August 1973, an amendment to the Federal Aid Highway Act permitted FHWA to approve use of Federal aid highway funds to abate noise on previously constructed highway projects.[212]

The levels are not single-event or "peak" levels. Instead, they represent averages of acoustic energy over short periods of time such as 8 or 24 hours and over long periods of time such as years. For example, occasional higher noise levels would be consistent with a 24-hour acoustic energy average of 70 dBA, so long as a sufficient amount of relative quiet is experienced for the remaining period of time.

One of the purposes of the document is to provide state and local governments with a basis for setting ambient noise standards. The information contained in the document must be integrated with other relevant factors such as the balance between costs and benefits associated with setting standards at particular noise levels, the nature of the existing or projected noise problems in any particular area, local aspirations, and the means available to control environmental noise.

Noise from Products

Under the Noise Control Act, EPA is required to set noise emission standards for products distributed in interstate commerce that are identified as major sources of noise. As a basis of these standards, EPA is required to conduct studies on the impact of noise on public health and welfare and the levels of environmental noise which must be maintained in order to protect public health and welfare with an adequate margin of safety. In addition, the agency must publish reports that identify products that are major sources of noise and provide information on techniques for control of noise from such products, including available data on technology, costs, and alternative methods of noise control.

In July 1973, EPA issued the first of these reports, *Public Health and Welfare Criteria for Noise.*[213] The report affirmed that exposure to high levels of noise is potentially detrimental to work performance and efficiency and to human health, and that hearing loss from noise can be suffered not only by workers in noisy occupations but also by the general population as a result of environmental noise.

The report stated that the relationship between noise and health is not yet fully understood. Although noise can cause many physiological responses, there is no clear evidence showing that these responses lead to irreversible changes or to permanent health effects. Whereas high noise levels do appear to have potentially detrimental effects on performance and on accident rates and absenteeism in industry, especially when it is intermittent, unexpected, or uncontrollable, the effects of moderate noise on performance are not clearly defined. The report concluded that noise exposure can be presumed to cause general stress, but the relationship between noise exposure and stress, or the threshold noise limits or duration at which stress may appear, is still unresolved.

The report on levels of environmental noise necessary to protect

Exposure to high levels of noise is potentially detrimental to work performance and human health.

public health and welfare was published in April 1974.[214] The document identified a 24-hour exposure level of 70 dBA as the level of environmental noise which will prevent any measurable hearing loss over a lifetime. Levels of 55 dBA outdoors and 45 dBA indoors are identified as preventing annoyance and not interfering with spoken conversation and other activities such as sleeping, working, and recreation.

Pollution Control at Federal Facilities

The efforts of the Federal Government to keep its own environmental house in order are one important yardstick of its commitment to protect the environment.

Funding for the control of pollution from Federal facilities has increased steadily during recent years, from $115.7 million in 1971 [215]

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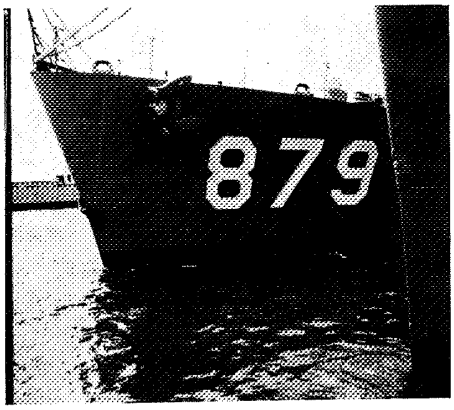

The Federal Government is taking action so that its ships do not contribute to marine pollution.

to an expected outlay of $392 million in fiscal 1975.[216] These funds are expended by a large number of Federal agencies on a wide range of pollution control activities.

Several Federal agencies, for example, are currently involved in efforts to control vessel pollution. As part of a 9-year program involving costs in excess of $1 billion, the Navy is adopting a technique that utilizes "collection handling and transfer tanks" as a means of holding oily and other sewage wastes. The end result is in-port transfer to local sewage systems rather than open sea dumping. Similar systems are being employed by the Coast Guard, the Corps of Engineers, and the National Oceanic and Atmospheric Administration.

Many Federal agencies are in the process of upgrading pollution abatement facilities. Federal facilities which require discharge permits under the 1972 Amendments to the Federal Water Pollution Control Act are modifying and improving their systems in order to meet the 1977 effluent limitation deadline. The emphasis at many veterans' hospitals is on improvement of incinerator performance.

In addition to budgetary increases in the Federal facility cleanup effort, two important Executive Orders were revised and strengthened during the last year.

To implement Section 306 of the Clean Air Amendments of 1970,[217] the President had issued Executive Order 11602 in June 1971.[218] That Executive Order required the Federal Government to use its procurement activities, grants, and loans to help achieve air pollution control goals. Except in special exemption cases, no Federal agency would be allowed to enter into a contract with, or extend Federal assistance by way of grant or loan to, any firm or individual whose program or activity involved the use of a facility designated by the Administrator as having given rise to a conviction for an offense under Section 113(c)(1) of the Clean Air Act.

In September 1973, the President superseded Executive Order 11602 with Executive Order 11738.[219] The new Order significantly expands the Federal Government's pollution control efforts by

extending the financial constraints to firms and individuals violating water quality standards under the Federal Water Pollution Control Act.[220] Thus, all Federal agencies are now under Executive mandate to undertake all procurement and financial assistance activities in a manner that will assure the effective enforcement of both air and water pollution control laws.

Executive Order 11752,[221] issued in December 1973, superseded a less comprehensive order, Executive Order 11507, of February 1970.[222] The new Order commits the Federal Government to a leadership position in cleaning up all "environmental pollution" connected with the "design, construction, management, operation and maintenance of its facilities." The Order acknowledges the significant and expanding role of state, interstate and local governments, and of the Federal Government's obligation to work harmoniously with representatives at those levels. As the newly designated administrator of Executive Order 11752, the Administrator of EPA is charged with a number of responsibilities having both long- and short-term impacts. As one example, the Administrator is called upon to initiate, develop and implement government-wide "coordinated strategies" and "integrated approaches" which will assure effective and efficient Federal agency compliance.

Costs of Pollution Abatement

Every year the Council estimates the abatement costs associated with current environmental programs.

This year's estimates, covering the period 1973 through 1982, are presented in Table 12 and in the appendix to this chapter. The Nation is expected to spend $194.8 billion from 1973 through 1982 for environmental improvement as a result of Federal environmental legislation.[223] Although this estimate is almost one-third higher than last year's, the ratio of each year's estimated abatement cost to the projected Gross National Product for that year varies from 0.7 percent (1973) to slightly over 1 percent through the remainder of the decade.

The estimate given in Table 12 is the CEQ's "incremental" cost estimate which was presented for the first time in last year's Annual Report.[224] This estimate represents expenditures which can be attributed to Federal environmental legislation enacted since the middle of the 1960's. The Nation has always made some expenditures on controlling pollution (for example, on collecting garbage or providing some municipal sewers) even in the absence of Federal legislation. These costs are included in the "total" cost estimate presented in Appendix 1 to this chapter. Although substantial interest in past years has been expressed in the "total" cost estimate, the Council

believes that the more important number is the "incremental" cost estimate presented in Table 12. This estimate represents the cost implications of the regulations and standards being issued and enforced by Federal, state, and local governments pursuant to current Federal environmental legislation.

Appendix 1 also contains a description of the methodology, assumptions, and data sources used in making these cost estimates. The predominant data sources were EPA's 1974 edition of *The Cost of Clean Air,*[225] and its 1973 edition of *The Economics of Clean Water.*[226]

Reasons for Increased Cost Estimates

Approximately one-fourth of the increase in estimated costs over last year's estimate is explained by inflation. This year's estimate is based on 1973 prices, whereas last year's was based on 1972 prices.

Another one-half of the increase results from shifting the period covered, from 1972–81 in last year's estimates to 1973–82 in this year's. In effect, a relatively high-cost year (1982, which comes at the end of the clean-up process) is added, while a relatively low-cost year (1972, which came before many of the expenditures actually were made) is dropped. The remaining one-quarter of the estimated cost increase is an increase in real costs. This is a combination of substantially increased costs for air pollution abatement, which are contained in the 1974 edition of *The Cost of Clean Air,* and reduced cost estimates in other sectors, such as water pollution abatement in the utilities sector.

Investment, Capital, O&M, Annual, and Cumulative Costs

Appendix 1 defines the various elements of the cost estimates and explains how they were obtained. Briefly, all costs are in terms of 1973 prices. Investment costs are the actual expenditures on construction and equipment for pollution abatement. "Capital costs" are the sum of capital depreciation and interest charges. Operating and maintenance (O&M) costs are the costs of the labor, energy, and materials consumed in operating and maintaining pollution control equipment, including the higher costs of low-sulfur fuel oil when this is substituted for high-sulfur fuel for pollution abatement purposes. Annual costs in any year are then the sum of the "capital costs" and O&M costs for that year.

Cumulative costs are the sum of the costs for each of the 10 years, 1973 through 1982. Thus the "cumulative annual costs" are the sum of the annual costs from 1973 to 1982.

Table 12

Estimated Incremental Pollution Control Expenditures [1]

[In billions of 1973 dollars]

Pollutant/medium	1973 O&M [2]	1973 Capital costs [3]	1973 Total annual costs [4]	1982 O&M [2]	1982 Capital costs [3]	1982 Total annual costs [4]	Cumulative—1973–82 Capital investment	Cumulative—1973–82 O&M [2]	Cumulative—1973–82 Total annual costs [4]
Air pollution									
Public	0.1	0.1	0.2	0.5	0.2	0.7	1.7	3.8	5.4
Private									
Mobile	1.2	0.2	1.4	8.4	4.9	13.3	31.3	49.9	74.4
Stationary	1.0	1.0	2.0	4.0	2.3	6.3	16.3	31.2	53.5
Total	**2.3**	**1.3**	**3.6**	**12.9**	**7.4**	**20.3**	**49.3**	**84.9**	**133.3**
Water pollution									
Public									
Federal	0.2	NA	NA	0.2	NA	NA	1.8	NA	NA
State and local	1.1	0.1	1.1	1.4	1.3	2.7	14.8	12.8	24.4
Private									
Industrial	0.5	0.5	1.0	1.5	1.2	2.6	9.8	12.3	23.1
Utilities	<0.05	<0.05	0.01	0.4	0.3	0.7	4.4	2.2	3.5
Total	**1.8**	**0.6**	**2.1**	**3.5**	**2.8**	**6.0**	**30.8**	**27.3**	**51.0**
Noise	NA	0.1	NA	NA	1.0–1.4	NA	6.0–8.7	NA	NA
Radiation									
Nuclear power plants	NA	NA	NA	<0.05	0.05	0.07	0.3	0.08	0.3
Solid waste									
Public	0.1	0.1	0.2	0.3	0.1	0.4	1.0	2.2	2.9
Private	0.1	<0.05	0.1	0.5	<0.05	0.5	<0.05	2.3	2.3
Total	**0.2**	**0.1**	**0.3**	**0.8**	**0.1**	**0.9**	**1.0**	**4.5**	**5.2**
Land reclamation									
Surface mining [5]	0.3	0	0.3	1.6	0	0.6	0	5.0	5.0
Grand total [6]	**4.6**	**2.0**	**6.3**	**18.8**	**10.4**	**28.0**	**81.4**	**121.8**	**194.8**

[1] Incremental costs are expenditures made pursuant to Federal environmental legislation, beyond those that would have been made in the absence of this legislation.

[2] Operating and maintenance costs.

[3] Interest and depreciation.

[4] O&M plus capital costs.

[5] Includes only coal mining.

[6] Does not include noise control.

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Distribution of Costs

Distribution over Time—The time distribution of investments is expected to increase from the beginning of the decade through 1976, after which the amount invested, particularly for air pollution control, falls off rapidly. (After 1977, investment costs will be primarily for new plants or for replacing worn-out equipment in older plants.) O&M and annual costs are expected to increase rapidly through 1977 and then level off.

Distribution between Investment and O&M Costs—Approximately three-fifths of the cumulative annual costs is estimated to be operation and maintenance costs, and the other two-fifths capital costs (one-third of the capital costs being for converters on automobiles). In fact, there is evidence that even this breakdown overstates the amount of capital being invested. The results of a recent Department of Commerce survey, reproduced in Appendix 2 to this chapter, indicate that actual capital expenditures are perhaps 10 percent less than those estimated by the CEQ. This result is not surprising, given the bias in the CEQ estimates in favor of "end-of-the-pipe" investments compared to the lower-cost, process changes being widely adopted by industries. There are as yet no empirical data available to indicate whether CEQ's estimates of O&M costs are overstated or understated.

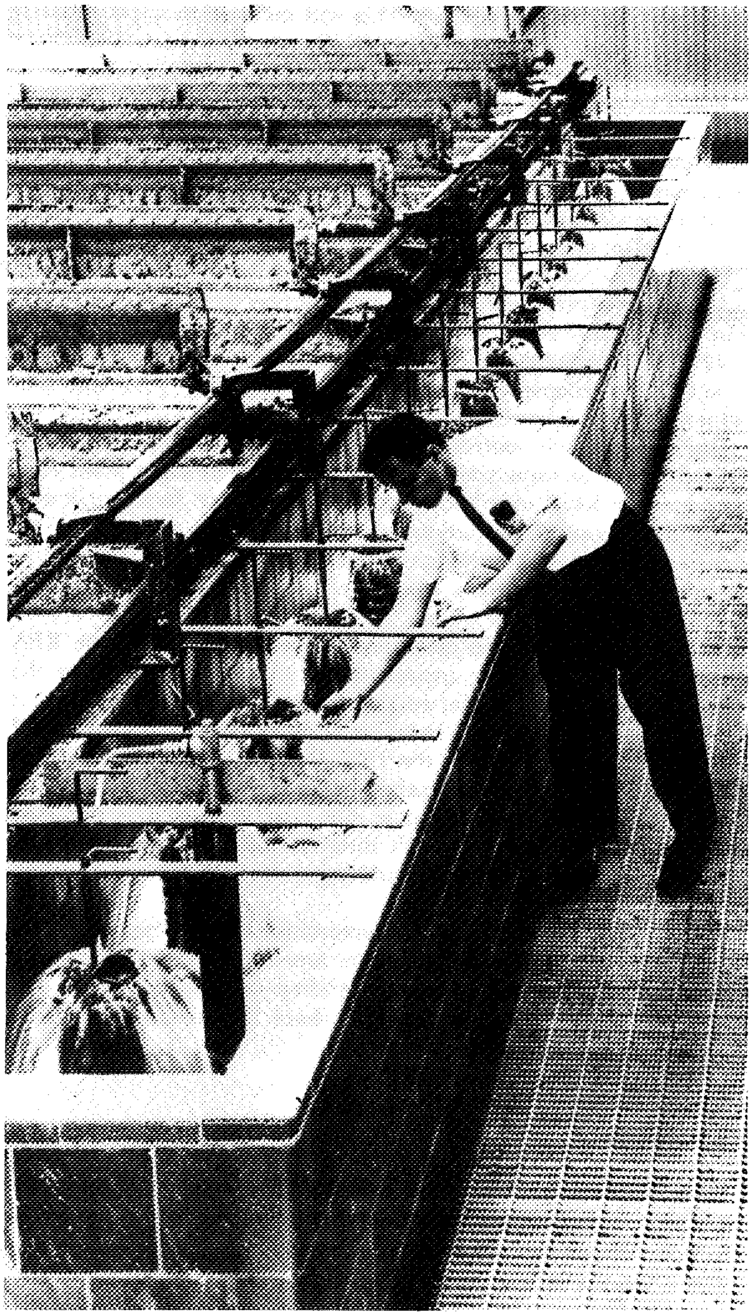
Distribution between Sectors—Approximately one-sixth of the incremental costs will fall on the public sector, predominantly for the construction and operation of municipal sewage treatment plants. These costs will be reflected in higher taxes and higher water and sewer charges.

One-third of the costs is for pollution abatement for private automobiles and is essentially paid for directly by the consumer when he purchases and operates his car. Approximately one-sixth of the costs is expected to fall on electric generating plants and to be passed on to the consumer in higher utility prices. The remainder of the costs fall on other industries and will ultimately be reflected in higher prices for goods and services to the consumer.

Impact of Costs

In order to evaluate the relative importance of these pollution abatement costs on the economy, it is useful to make some comparisons. For instance, the annual abatement costs are presently running at approximately three-quarters of 1 percent of our GNP. Over the decade they are expected to increase to slightly more than 1 percent of GNP before their relative importance begins to fall again.

Viewed another way, the average cost per person in the United



An increasing number of industries, like this paper mill, are building plants to treat their own wastes.

States was $35 to $40 in 1973. This will increase to approximately $80 in 1976 and then fall off. The 1976 costs are expect to be about 2 percent of median family income.[227]

Pollution control investments (excluding those for mobile sources) are now running at less than 2 percent of total private domestic investment but about 5 percent of industrial plant and equipment expenditures (see Appendix 2). This proportion of plant and equipment expenditures is expected to remain approximately constant through 1976, after which it is expected to fall.

During the past year, there is little evidence that environmental expenditures contributed in any significant way to the country's inflation. Less than one-half of 1 percent of the inflation rate could reasonably be attributed to pollution control. This inflationary impact is expected to become somewhat worse in 1976 and 1977 but still be in the range of 1 to 2 percent.

Nor are pollution control expenditures expected to be responsible for significant unemployment problems. Although some plant closings, causing local unemployment problems, have been attributed to pollution control regulations, most of these are older, marginal plants, usually having limited production capacity. In many instances the plants might well have closed even in the absence of environmental regulations.

In terms of impacts on government finances, although the EPA grants program for waste treatment plants and sewers is now the second largest Federal public works program in terms of obligations, it still remains relatively small in terms of other Federal programs. Of 14 functional areas listed in the 1975 Federal budget, Natural Resources and Environment comprised by far the smallest area in terms of 1974 outlays.[228] However, over the next 2 years it is expected to pull approximately even with international affairs and finance, space research and technology, and agriculture and rural development.

In terms of impacts on local expenditures, the current Federal programs appear to be reducing the amount that state and local governments would otherwise be spending on environmental programs because of the large Federal share of current wastewater treatment plant expenditures.

Conclusions

This year's estimates indicate that pollution control expenditures are higher than they had previously been thought to be. Nevertheless, they still are not expected to have any significant general economic impact in terms of effect on GNP growth, inflation, or unemployment. However, some industrial sectors are impacted more seriously than others. It is important in implementing our environmental regulations to pay particular attention to these sectors, in order

to ensure that the desired degree of pollution abatement occurs as efficiently as possible and with as little disruption to the industry and the general economy as is feasible. The Council is continuing its analyses to that end.

Protecting Our Natural Heritage

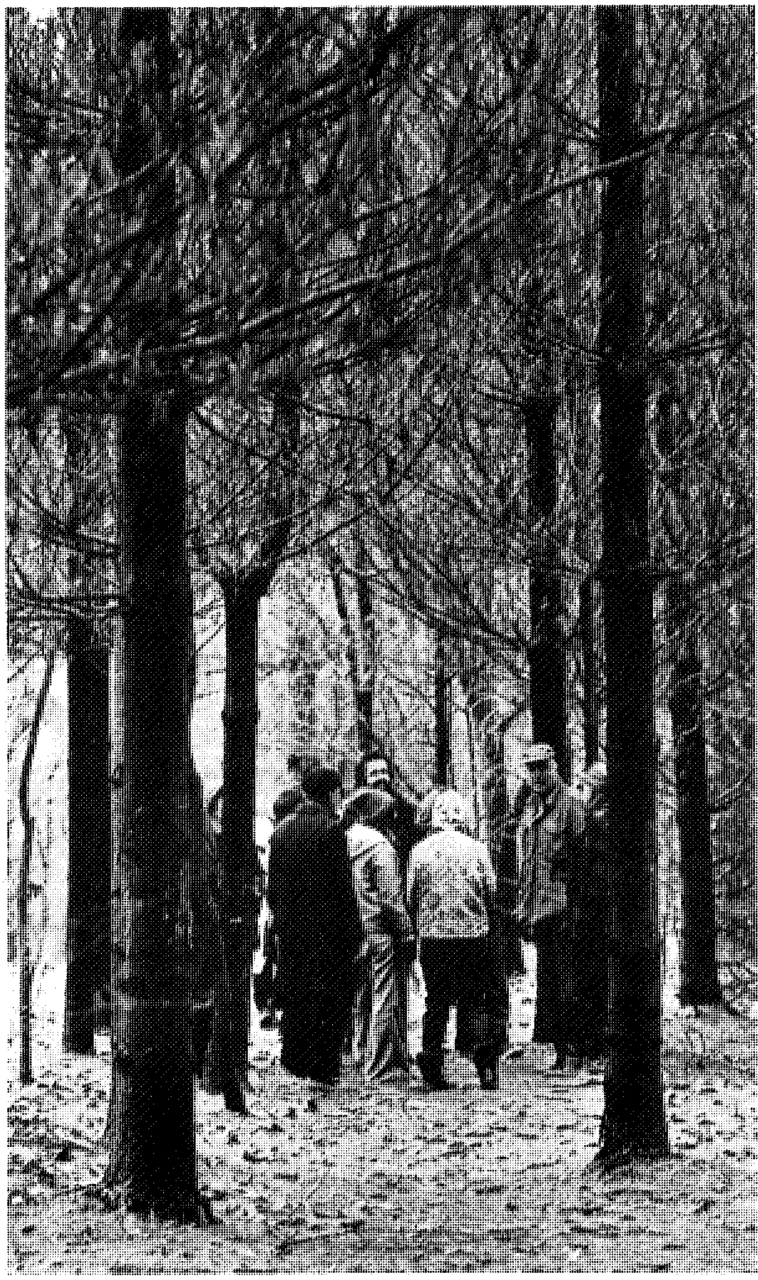
Our Nation's natural heritage, rich in wild animals and plants, wild lands, scenic wonders, and open space, constitutes one of our most valued resources. It is also a fragile resource, particularly vulnerable to the impacts of man's activities. As a Nation, we have led the world in the protection and conservation of natural values. Nevertheless, important gaps in our protection of these values still remain. This section discusses major developments in the past year in government programs to protect our natural heritage. Most of these developments contribute to environmental quality; some, such as misuse of off-road vehicles, are clearly detrimental to conservation of our natural heritage. This section does not assay a comprehensive listing, but rather seeks to put some of the many significant actions and trends into perspective.

Wildlife

Wildlife Management

Until recently, hunters and fishermen have been the most effective national wildlife constituency, as well as the major source of fish and wildlife management funds. As a consequence, fish and wildlife management has developed largely as game management. In 1969 (the last year for which comprehensive figures are available), only 4 percent of the $142 million spent by all sources for wildlife management, research, and habitat acquisition was expended for clearly non-game purposes.[229] This estimate somewhat overstates the concentration on game management. Game-related funding which improves habitat benefits non-game wildlife as well. More recently, funds have been spent on non-game wildlife, largely because of the Endangered Species Act of 1969. Nevertheless, most wildlife effort is still concentrated on a few game species—which represent a small fraction of the Nation's 400 species and subspecies of mammals and 800 species of birds—and is still financed by licenses and taxes on sporting goods paid by hunters and fishermen, who make up a small percentage of the population.

A New Orientation—Recent years have brought an increasing recognition of a broad spectrum of wildlife values other than the harvest of a shootable or fishable surplus. Recent legislation cites aesthetic, educational, historical, recreation, scientific, economic, and



Nature study, wildlife viewing and photography, and other non-consumptive uses of wildlife have far outstripped hunting and fishing use of the Nation's wildlife resources.

ecological values of wildlife to the Nation and its people.[230] The ecological role of wildlife, in particular, is reflected in recent legislation and court decisions. The Marine Mammal Protection Act of 1972,[231] for example, established as the primary objective of policy and management the survival of marine mammals in adequate numbers to play their role in the ecosystem; any management for consumption must be consistent with that primary objective. And in a landmark decision in 1970, the New York State Court of Appeals upheld the constitutionality of the State's Mason Act (an act to protect depleted and endangered species of wildlife) on the grounds that the State must protect the animals for their key ecological role as well as for their aesthetic value and for scientific study. The court ruled that the legislature may appropriately conclude that protection of these animals is essential for the welfare of society.[232]

Although statistics are difficult to obtain, available figures for use of lands administered by the Bureau of Land Management (BLM) and the Forest Service show a trend toward dramatically increasing public interest in viewing and photographing wildlife. Data on visitors show that hunter use has remained relatively stable during recent years, while nonconsumptive wildlife visits have increased greatly, up to 25 percent per year in some cases.[233]

Unfortunately, the development of this broader interest in wildlife has been accompanied by growing hostility between hunters and non-hunters and widespread identification of wildlife management with hunters and killing. Under American law and custom, sport hunting—properly regulated and based on scientific principles—is considered a legitimate management technique as well as a form of recreation. Since the development of modern wildlife management in the 1930's, no American wildlife has been exterminated by sport hunting. On the contrary, wildlife management has restored many depleted or threatened species, including the pronghorn, key deer, alligator, sea otter, fur seal, beaver, wild turkey, and trumpeter swan. In 1890, the total U.S. population of white-tailed deer was around 350,000 animals; in 1907, the official estimate of elk was around 41,000; as recently as 1930, the wild turkey was common in only a few southern states. Today, there are more than 12 million white-tailed deer and about a million elk south of Canada, and the wild turkey is found in 43 states.[234] In short, what is required is not simply pro-hunting or anti-hunting management but a balanced national program of wildlife management which gives consideration to all species and which recognizes hunting and nonconsumptive uses of wildlife as requiring different but related management techniques.

The wildlife profession has begun to recognize and act on this. The Wildlife Management Institute issued a North American Wildlife Policy statement in 1973 which stressed the new importance of aesthetic and ecological values and called for balanced wildlife management.[235] The Wildlife Society, in cooperation with the International Association of Game, Fish, and Conservation Commissioners

(which represents state wildlife departments) in 1972 developed model state legislation for non-game wildlife, parts of which are now in various stages of implementation by 35 states.[236]

At the Federal level, several steps have been taken during the past year to broaden the "fish and game" focus toward one of balanced wildlife management. The Bureau of Sport Fisheries and Wildlife in the Department of the Interior was reorganized both in Washington and in the field. To reflect the new orientation, the organization was redesignated as "the Fish and Wildlife Service," its original name.[237]

As pointed out earlier, most wildlife programs are now supported by revenues from sources related to hunting or fishing. The Federal Aid in Wildlife Restoration Act of 1937 [238] provides grants to states from funds derived from Federal excise taxes on sporting goods. State legislation for the most part is also funded by hunters and fishermen. In order to reflect and support the broader orientation toward wildlife, CEQ and the U.S. Department of the Interior (USDI) have commissioned a study to develop a more balanced national wildlife program.

The Importance of Habitat—The greatest disturbance to wildlife is alteration of habitat by man. In some cases, man's activities benefit certain types of wildlife. For other types, loss or degradation of habitat poses a fundamental threat to continued existence. Agriculture and forestry practices provide striking examples of varied effects of human actions.

Agricultural lands provided excellent wildlife habitat in the past when farm holdings were relatively small, crops diversified, and hedge rows and vegetated stream banks common. However, the development of larger holdings without intervening forest groves and hedge rows greatly reduced available wildlife habitat. Even the 40 to 60 million acres of land removed from farming during the 1950's and 1960's through the Soil Bank and Set-Aside programs were at best only partially successful in providing soil cover and wildlife habitat.[239] Some incentives for better protection of wildlife, such as longer set-aside periods, were included in the Agricultural Act of 1973, which provided for the continuance of the Set-Aside Program for another 3 years.[240] But the food supply situation in the past year has caused many of the previously idled acres to be put back into production, with significant effects on fish and wildlife through loss of cover and through erosion.

Domestic livestock grazing is another form of agriculture affecting wildlife. Historically, overgrazing has been a major factor in destroying wildlife habitat. Overgrazing remains a serious problem today on many range lands, and scientists believe that it is a cause of declining deer populations in parts of the West.[241]

In forestry, many management practices benefit wildlife; when they create a diversity of habitat, in particular, forestry practices can foster a diversity of wildlife. But intense management of one species or one age class of trees can prove harmful to diversity. Generally, the more

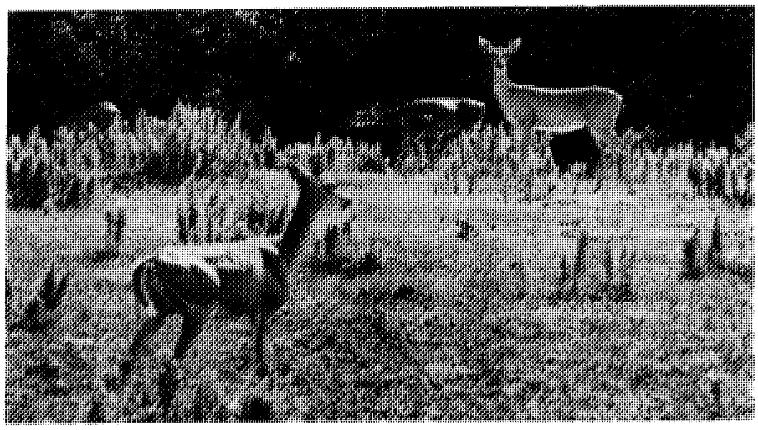
forest management policy leans toward even-aged monoculture, the less benefit wildlife receives from the practices.[242]

When the first Europeans arrived in what is now the eastern United States, vast areas were covered by mature forests. Wildlife of second-growth forests was relatively rare. With clearance of the land and extension of forestry, many of these species extended their ranges and became common. The chestnut-sided and mourning warblers, hardly known by early ornithologists, are now abundant. Regrowth of cutover forest lands and abandoned fields is optimum for them, and hence the transformation of large areas of uniform forests to a patchwork of successional stages created extensive habitat niches for which these warblers are adapted.

American deer provide another example. The deer is an "edge animal"; it cannot find both optimum food and cover in either open grassland or mature forest. Largely because man has broken up the large forests and grasslands into a nationwide system of "edges," the population of deer is now greater and the range more extended than they were 300 years ago.

Clearcutting, perhaps the most controversial type of forest management, can be beneficial to many wildlife species if the areas cut are relatively small and spaced over time. Large block clearcutting followed by artificial regeneration, however, creates a monoculture which does not provide as much food and shelter to wildlife as a heterogeneous stand. In its most extreme form—artificial regeneration, particularly of a single species, and removal of competing vegetation through the use of herbicides—forest management bypasses the normal succession in a forest and creates an environment in which a diversity of wildlife cannot thrive.

Mature or dead trees and logs, which may be unaesthetic, inefficient, and uneconomic from the standpoint of the forester, are es-



The White-Tailed Deer is an "edge animal." Human activities have created edge conditions throughout North America, expanding and improving the habitat for these deer.

sential for much of the forest wildlife. Fully 40 percent of forest bird species nest in cavities in dead trees and logs.[243] Snags in national forests in California are used by 30 species of birds, 20 species of mammals, and thousands of other organisms, many of which are primary food for higher forms of wildlife.[244] Species of birds and other forms of wildlife that require mature forests may be reduced to relic populations if the removal of dead and diseased trees and snags continues on a large scale.

All human activities affect wildlife habitat in some way: directly, as in logging, farming, and channelization; or indirectly, as with livestock grazing, pesticide use, and introduction of exotic species. Today, while protection from exploitation remains important for a few species (e.g., some predators), habitat management is the key to most effective wildlife conservation.[245]

Endangered Species

One of the most significant wildlife events during the past year was the passage of the Endangered Species Act of 1973,[246] first proposed in the President's 1972 Environmental Program. The Endangered Species Preservation Act of 1966[247] had provided the first official recognition of the loss suffered when a species of wildlife is forced into extinction. But that Act provided only limited authority to protect or conserve endangered species. It was amended and amplified by the Endangered Species Conservation Act of 1969,[248] which recognized that actions carried out in the United States could have an adverse effect upon the survival of wildlife in other nations. The 1969 Act provided authority to determine species threatened with "world-wide extinction" and to regulate the importation into this country of those species or of products made from them.

The Endangered Species Act of 1973 provides a further broadening of authority. It gives consideration to all animal life, not only the vertebrates, mollusks, and crustaceans included under the previous law, and recognizes the importance of wild plants as well as animal species. It provides for protection of "threatened" as well as "endangered" species, permitting preventive action before a critical stage is reached and thereby enhancing the likelihood of successful recovery. It authorizes a grant program to assist state endangered species programs, and provides for Federal protection of resident species where states are unable to do so. It requires coordination among all Federal agencies whose activities may impact threatened or endangered species or their habitats, and directs these agencies to use their other authorities in furtherance of the purposes of the Act. This requirement may be the most significant in the Act, since such coordination should greatly lessen the chance of accidentally pushing a species into the endangered category. Finally, it implements the Convention on International Trade in Endangered Species of Wild Fauna and Flora, making the United States the first nation to

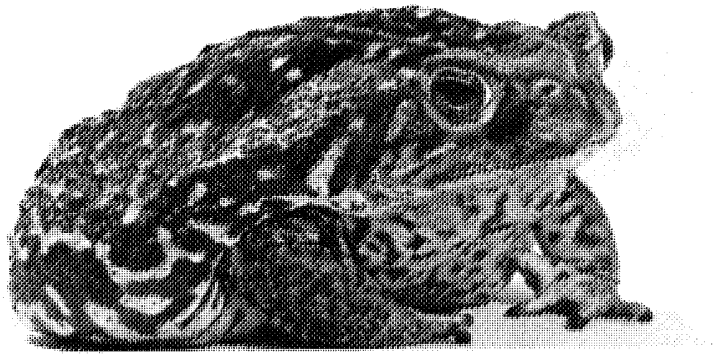
California Condor. Only about 50 individuals of this seriously threatened species remain.

ratify this treaty which was negotiated by over 80 nations in Washington in March 1973 and now has been signed by nearly 50 nations.

To assist the various states in participating fully in the Endangered Species Conservation Program, Federal officials, working with organizations such as the International Association of Game, Fish, and Conservation Commissioners, have drafted a Model State Endangered and Nongame Species bill which is intended to provide sufficient statutory authority for a state to comply with the Federal statutes.

Exotic Species

During recent years this Nation has suffered in many different ways due to the importation of exotic (that is, nonnative) wildlife. Native wildlife has been threatened by introduced species. Rats and mongooses brought into the United States have threatened native birds and mammals; walking catfish and other exotics compete with or prey upon native fishes; and some 50 species of native freshwater snails are threatened or have been eliminated by an introduced snail. Agriculture has suffered; the poultry industry, for example, recently lost millions of dollars due to the introduction of a strain of Newcastle disease. In 1973 the disease, brought in by parrots and myna birds, caused the loss of over 11 million chickens in California.[249] Many cases of human injury or illness have been traced to exotic species, for such species often carry diseases or serve as hosts for parasites that affect man. Imported monkeys, for example, can infect humans with tuberculosis and hepatitis. Numerous cases of psittacosis led to the control of parrot importations in the 1930's. Other birds, snails, and primates may carry human pathogens, and small turtles bought in pet stores are estimated to cause 40,000 cases of salmonella poisoning a year. Bites from captive or escaped wild species—from lizards



This marine toad—introduced from Central and South America by the animal trade and now established in Florida—reaches a foot in length, is carniverous, and secretes poison through its skin.

to lions—are an increasing problems.[250] The Director of the U.S. Fish and Wildlife Service said recently that "current information shows that injury caused by imported wildlife is more widespread and serious than previously believed."

The Lacey Act, enacted in 1948, requires the Federal Government to protect human beings, agriculture and wildlife from injury caused by imported wildlife by regulating its importation.[251] Potentially injurious wildlife may be imported only under permit and only for scientific, educational, medical, or zoological purposes.

Historically, however, Federal sanctions under this Act have not been imposed until a species actually causes injury. As that point it is named to a list of "Injurious Species" and further importations are regulated. But this procedure has failed to give adequate protection against injury by an introduced species and also allows troublesome species to become established in the wild. Once established, control or eradication of such exotics is expensive and rarely successful.

The problem is a significant one. Hundreds of thousands of living birds and mammals, millions of reptiles and amphibians, and over 100 million living fish are now imported into the United States each year.[252] Under present regulations, few if any restrictions are imposed on the purpose for which they are imported, the qualifications of the person under whose care they are imported, the qualifications of the importer and the buyer, or the adequacy of the facilities in which the species will be housed.

To solve this problem, USDI has proposed new regulations based on the concept that any exotic species can pose a serious threat; importation of any wild, living vertebrate, mollusk or crustacean would be regulated under the Lacey Act and require a permit.[253] Only specifically identified "Low Risk" species could be imported without a permit.

This system would protect human health, agriculture and wildlife

by insuring that exotic animals which pose a significant threat are imported only under carefully regulated circumstances by qualified persons. Yet it would allow a simplified procedure for importing creatures which do not pose such a threat.

Predator Control

Predator control programs on grazing lands have seriously affected many wildlife populations and are responsible for putting species such as the northern Rocky Mountain wolf, eastern timber wolf, red wolf, kit fox, eastern cougar and Utah prairie dog on the Endangered Species list.[254]

Widespread use of poisons in predator and rodent control programs, particularly on public lands in the West, led CEQ and the Department of the Interior to appoint an Advisory Committee on Predator Control in 1971 to study this practice and make recommendations. Its report [255] found that persistent poisons had been widely applied to range and forest lands without adequate knowledge of how they affect the environment, and that the poisons represented a threat to beneficial animal life and entire ecosystems. The Committee concluded that necessary protection could be afforded livestock without the routine use of poisons and recommended that such use be stopped.

In response, the President in 1972 issued an Executive Order barring the use of poisons, except in emergency situations, for predator control on public lands and in Federal programs.[256] EPA subsequently suspended and cancelled registration for poisons used in predator control.[257] The President also proposed legislation to shift the emphasis of current Federal programs toward research and toward technical and financial assistance to states to control predators by means other than poisons. The basis of the new policy was to control those individual predators causing damage rather than attempting to reduce or eliminate whole predator populations.[258]

After the Executive Order was issued, the Department of the Interior expanded both its non-toxic predator control efforts and its research on predators and their control. The first full year of control without poisons ended in December 1973. Data indicate that the new approaches are at least as effective—in terms of both predators killed and livestock protected—as control measures based on poisons. There have been no significant changes in overall livestock losses to predators; whereas some ranchers have suffered increased losses, others have had equal or reduced losses.[259]

The major predator problem involves coyotes attacking sheep in the West. Coyote populations fluctuate in response to a variety of factors, including disease and food supply as well as control efforts. During the years just prior to the poison ban, coyote population increased throughout the 17 western states. During 1973, the number of coyotes continued to increase in five states east of the Continental

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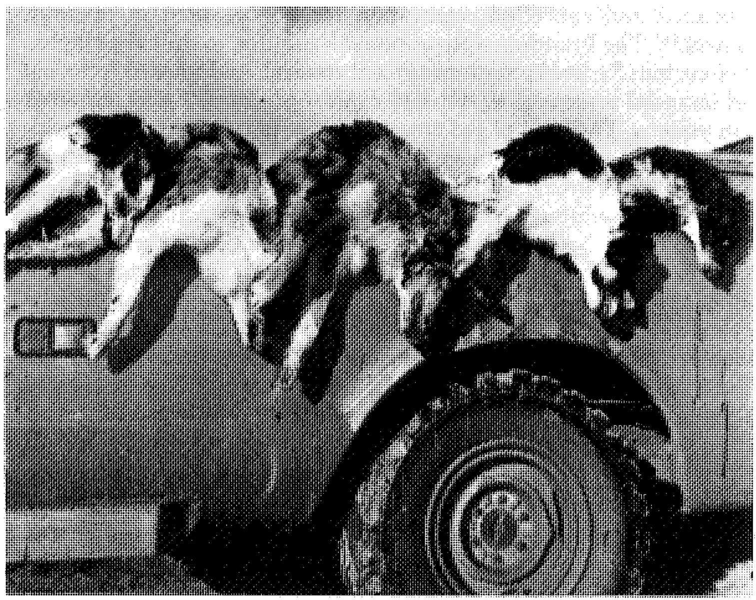
A government predator hunter in 1925 (top). The old notion that "the only good predator is a dead one" is no longer acceptable. Sheep dogs accidentally killed by M–44 cyanide guns set out to poison coyotes (bottom).

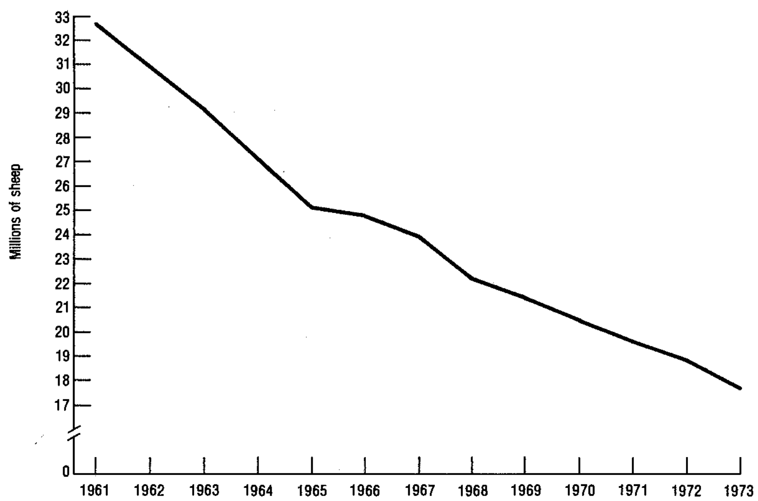


Divide, but in nine states the change was insignificant, and the number decreased significantly in three states west of the Divide.[260] Contrary to some reports, the poison ban has not resulted in a dramatic increase in coyotes.

The ban has also not resulted in significant increases in overall predation losses, nor is it causing the decline of the sheep industry, contrary to the belief of some segments of that industry. The sheep industry has been declining for many years. As Figure 2 shows, the number of sheep in the United States has declined from 32,725,000 in 1961 to 17,726,000 in 1973.[261] The decline of 5.0 percent in 1972 and 5.3 percent in 1973 simply continued the average annual decline of 5.0 percent experienced during the previous decade. Although coyote predation appears to represent roughly 25 percent of total sheep losses in the 17 western states, total losses of sheep from all causes in these states (ewes 7.2 percent, lambs 11.5 percent) are lower than in the eastern 31 states (ewes 9.0 percent, lambs 12.7 percent) where coyotes are not significant,[262] and the overall decline in total numbers of sheep has been less in the western 17 states than in the rest of the United States both before and after the poison ban.[263] Clearly, coyotes have not been responsible for driving the U.S. sheep industry out of business, either before or after the poison ban.

Figure 2

Number of Sheep and Lambs in United States, 1960-73



Source: U.S. Department of Agriculture, Economic Research Service/Statistical Reporting Service, Agricultural Marketing Service, *Livestock and Meat Statistics,* Statistical Bulletins No. 502, (January 1973) and 522 (January 1974).

Nevertheless, losses due to coyotes can be very significant to individual ranchers. To help these individuals during the lambing period of 1974, the Department of the Interior reprogrammed $450,000 for accelerated non-poison predator control operations and, in cooperation with USDA, EPA, CEQ, and the Department of Health, Education, and Welfare (HEW), established more effective procedures to help ranchers in emergency situations under the provisions of the Executive Order.[264]

Furthermore, new emphasis has been given to the development of more effective and environmentally sound methods of predator control. Interior has accelerated its research efforts from $300,000 in FY 1973 to $1.1 million in FY 1974. It has requested $2 million from Congress for FY 1975. Over 80 individual research projects are under way with Federal, state, and private sponsorship. EPA has registered the M-44 (a safer device than previously used for delivering sodium cyanide) for experimental use on private lands in several states.

The days of the routine use of poisons for predator control on public lands are gone, as are the days when Federal programs sought to exterminate predators. The values of predators, along with those of the rest of our wildlife heritage, are now widely recognized by the general public. As the President stated in his 1972 message, "the old notion that 'the only good predator is a dead one' is no longer acceptable as we understand that even the animals and birds which sometimes prey on domesticated animals have their own value in maintaining the balance of nature." [265]

Parks, Wilderness, and Other Important Lands

Legacy of Parks

In 1971, the President announced the "Legacy of Parks" program designed to accelerate the acquisition and protection of natural heritage lands both at the state and Federal level. A major objective of the program has been to provide park and recreation areas near the urban areas where most of the Nation's people live.

One means to accomplish this objective has been the transfer of under-utilized Federal properties to states and localities for recreational purposes. By June 1974, 440 parcels totalling 64,000 acres and valued at $173.4 million had been selected for transfer to state and local governments in 50 states, Puerto Rico, Virgin Islands, Guam, and the District of Columbia.[266]

The 23,000 acre Gateway National Recreation Area near New York City and the 24,000 acre Golden Gate National Recreation Area near San Francisco, proposed by the President in 1971, were opened to the public in the spring of 1974. Situated in close proximity to the millions of people in two of our largest metropolitan concentrations,

these areas contribute significantly to the emphasis of the Legacy of Parks program on providing parks and recreation areas near the people.

Land and Water Conservation Fund

The Land and Water Conservation Fund provides another means by which heritage lands are added to the public domain. Since its inception in 1965, more than $1.8 billion has been expended under this program by Federal agencies and state governments. Over $600 million has been provided to Federal agencies to acquire over 1.3 million acres of land in National Parks, Recreation Areas, Historic Sites, Wildlife Refuges, and Wild and Scenic Rivers and National Scenic and Recreation Trails.

The Land and Water Conservation Fund provides monies to state and local governments on a matching basis. The non-Federal share can be met either by non-Federal funds or under appropriate circumstances, by equivalent value of donated lands, services, or materials. These grants cover both land acquisition and development of facilities, as well as support the formulation of statewide comprehensive outdoor recreation planning. Since 1965, the program has granted roughly $1 billion to the states.

In August 1973 the President signed into law the Agriculture and Consumer Protection Act of 1973 [267] which authorized the Secretary of Agriculture to enter into contracts with eligible owners and operators of private lands to assist them in enlarging fish, wildlife, and recreation resources. It also included an incentive program for private, nonindustrial forestlands, which is described below under Forestland Resources.

Public Wild Lands in Alaska

The Alaska Native Claims Settlement Act [268] became law in December 1971. Among other things, the Act called for a 2-year study leading to specific proposals for additions to the "four systems," National Parks, National Forests, Wildlife Refuges, and the Wild and Scenic Rivers System. This study was completed in December 1973, and the results proposed to Congress in legislation which would affect the disposition of almost 25 percent of the State's area.

The proposed legislation would add approximately 63.9 million acres of public lands in Alaska to the National Park and National Wildlife Refuge Systems, thereby more than doubling the areas presently protected by these systems. In addition, 18.8 million acres would be added to the National Forest System and 800,000 acres to the National Wild and Scenic River System.

Three new national parks are proposed: Gates of the Arctic in the

rugged and scenic Brooks Range; Lake Clark on the Alaskan Peninsula; and Wrangell-St. Elias in southeastern Alaska. Mt. McKinley National Park would be more than doubled in size. The Katmai National Monument would be enlarged and reclassified as a National Park. New national monuments would be created at Kobuk Valley, Cape Krusenstern, Aniakchak Caldera and Harding Ice Field—Kenai Fjords. Through designation as national rivers, the entire Charley River watershed and a portion of the upper Yukon River drainage would be added to the National Park System. The Chukchi-Imuruk National Reserve on the Seward Peninsula would be administered jointly by the Park Service and Fish and Wildlife Service.

The proposal also calls for nine new or expanded units of the National Refuge System to protect the fish and wildlife resources and their habitats. The largest of these is the vast Noatak National Arctic Range, proposed as an ecological range, which covers 7.59 million acres.

Twenty rivers are recommended as additions to the National Wild and Scenic Rivers System. Of these, 16 lie within the boundaries proposed as National Parks, Forests and Refuges.

Under the Native Claims Settlement Act, these lands will be protected for a period of 5 years, during which time the Congress will be considering these proposals.

Western Wilderness

The National Wilderness Preservation System was established by the Wilderness Act of 1964. The Act designated 54 areas as wilderness and established a procedure under which potential wilderness areas were to be evaluated by the Secretaries of Agriculture and Interior and recommendations concerning designation made by the President to Congress. The Wilderness Act required that specific candidates for wilderness areas be presented to Congress by the 10th anniversary of its enactment, September 3, 1974. Although the review and designation process under the Act was initiated relatively slowly, the process has been greatly intensified during the last several years to assure that the 1974 deadline will be met.

In the past year the President has submitted to Congress proposals to add 28 units, totalling 9,550,000 acres, to the National Wilderness System.

During the 10 years since the Wilderness Act was passed, a total of 206 units have been under review, of which 25 have been removed from the list. Forty units have been placed in the system by Congress, and another 80 are before Congress awaiting action. The remainder are under study by the departments. (See Table 13.)

Table 13

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated

Name	Acres[1]	Location	Sponsor	Status
Absaroka	64,000	Montana	FS	Under study[2]
Agassiz	61,487	Minnesota	FWS	Under study
Aldo Leopold	188,000	New Mexico	FS	Transmitted to Congress 2/28/72
Aleutian Islands	2,720,426	Alaska	FWS	Under study
Anaho Island	247	Nevada	FWS	Under study
Arches	15,703	Utah	NPS	Transmitted to Congress 4/28/71
Arctic	8,900,000	Alaska	FWS	Delayed due to ANCSA
Assateague	6,500	Virginia	NPS	Under study[2]
Agua Tibia	12,000	California	FS	Transmitted to Congress 2/8/72
Back Bay	4,588	Virginia	FWS	Under study
Badlands	58,924	South Dakota	NPS	Transmitted to Congress 9/21/72
Bandelier	21,110	New Mexico	NPS	Transmitted to Congress 11/28/73
Beartooth	230,000	Montana	FS	Under study[2]
Bering Sea	41,113	Alaska	FWS	Designated by Congress 10/23/70
Big Bend	533,900	Texas	NPS	Transmitted to Congress 11/28/73
Big Lake	10,974	Arkansas	FWS	Under study
Blackbeard	3,000	Georgia	FWS	Transmitted to Congress 9/21/72
Black Canyon of the Gunnison	8,780	Colorado	NPS	Transmitted to Congress 2/8/72
Black Water	11,216	Maryland	FWS	Under study
Blue Range	177,000	New Mexico[2] Arizona	FS	Transmitted to Congress 2/8/72
Bogoslof	390	Alaska	FWS	Designated by Congress 10/23/70
Bombay Hook	15,110	Delaware	FWS	Under study
Bosque del Apache	32,500	New Mexico	FWS	Transmitted to Congress 4/28/71
Breton	5,000	Louisiana	FWS	Transmitted to Congress 4/2871
Brigantine	4,250	New Jersey	FWS	Transmitted to Congress 9/21/72
Bryce Canyon	16,303	Utah	NPS	Transmitted to Congress 2/8/72
Buffalo	95,730	Arkansas	NPS	Under study[2]
Cabeza	833,500	Arizona	FWS	Transmitted to Congress 6/13/74
Canyonlands	337,258	Utah	NPS	Under study
Cape Romain	28,000	South Carolina	FWS	Transmitted to Congress 2/28/72
Capitol Reef	23,054	Utah	NPS	Transmitted to Congress 4/28/71
Carlsbad Caverns	30,210	New Mexico	NPS	Transmitted to Congress 9/21/72
Cedar Breaks	4,370	Utah	NPS	Transmitted to Congress 4/28/71
Cedar Island	12,526	North Carolina	FWS	Under study

See footnotes at end of table.

Table 13—Continued

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated—Con.

Name	Acres[1]	Location	Spon-sor	Status
Cedar Keys	375	Florida	FWS	Designated by Congress 8/7/72
Chamisso	455	Alaska	FWS	Transmitted to Congress 4/28/71
Charles M. Russell	926,575	Montana	FWS	Under study
Chase Lake	4,155	North Dakota	FWS	Transmitted to Congress 9/21/72
Chassa-howitzka	16,900	Florida	FWS	Transmitted to Congress 9/21/72
Chincoteague	9,438	Virginia	FWS	Under study
Chiricahua	6,925	Arizona	NPS	Transmitted to Congress 2/8/72
Clarence Rhodes	2,887,026	Alaska	FWS	Delayed due to ANSCA
Cloud Peak	137,000	Wyoming	FS	Under study [3]
Colorado	7,700	Colorado	NPS	Transmitted to Congress 2/8/72
Crab Orchard	4,050	Illinois	FWS	Transmitted to Congress 6/13/74
Crater Lake	122,400	Oregon	NPS	Transmitted to Congress 6/13/74
Craters of the Moon	43,243	Idaho	NPS	Designated by Congress 10/23/70
Crescent Lake	24,502	Nebraska	FWS	Transmitted to Congress 11/28/73
Cumberland Gap	6,375	Maryland	NPS	Transmitted to Congress 9/21/72
Cumberland Island	20,176	Georgia	NPS	Under study
J. N. "Ding" Darling	4,307	Florida	FWS	Under study
Death Valley	1,596,500	California	NPS	Under study [3]
Deer Flat	11,585	Oregon-Idaho	FWS	Under study
Desert	1,322,900	Nevada	FWS	Transmitted to Congress 6/13/74
Desolation	63,469	California	NPS	Designated by Congress 10/10/69
Dinosaur	45,100	Colorado-Utah	NPS	Under study [3]
DuNoir		Wyoming	FS	Suggested by Congress for study
Eagle Cap Addition	72,420	Oregon	FS	Designated by Congress 10/21/72
Eagles Nest	88,000	Colorado	FS	Transmitted to Congress 2/8/72
Emigrant	106,000	California	FS	Transmitted to Congress 2/8/72
Everglades	764,700	Florida	NPS	Under study [3]
Farrallon	141	California	FWS	Transmitted to Congress 4/28/71
Flat Top	142,000	Colorado	FS	Transmitted to Congress 3/29/68
Florida Keys	4,740	Florida	FWS	Transmitted to Congress 9/21/72
Forrester Island	2,630	Alaska	FWS	Designated by Congress 10/23/70
Fort Niobrara	19,123	Nebraska	FWS	Under study

See footnotes at end of table.

Table 13—Continued

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated—Con.

Name	Acres[1]	Location	Sponsor	Status
Gila	130,000	New Mexico	FS	Under study[2]
Glacier	183,000	Wyoming	FS	Transmitted to Congress 2/8/72
Glacier	927,550	Montana	NPS	Transmitted to Congress 6/13/74
Glacier Bay	2,210,600	Alaska	NPS	Under study[3]
Glen Canyon	1,196,545	Utah	NPS	Under study
Grand Canyon	512,870	Arizona	NPS	Transmitted to Congress 9/21/72
Grand Teton	115,807	Wyoming	NPS	Transmitted to Congress 9/21/72
Great Sand Dunes	32,930	Colorado	NPS	Transmitted to Congress 9/21/72
Great Smoky Mountains	247,000	North Carolina-Tennessee	NPS	Under study[2]
Great Swamp	3,660	New Jersey	FWS	Designated by Congress 9/28/68
Guadalupe Mountains	46,850	Texas	NPS	Transmitted to Congress 9/21/72
Gulf Islands	163,200	Mississippi-Florida	NPS	Under study
Haleakala	19,270	Hawaii	NPS	Transmitted to Congress 9/21/72
Hart Mountain	16,500	Oregon	FWS	Transmitted to Congress 1/18/69
Havasu	2,500	California	FWS	Transmitted to Congress 6/13/74
Hawaii Volcanoes	123,100	Hawaii	NPS	Under study[2]
Hawaiian Islands	1,742	Hawaii	FWS	Transmitted to Congress 6/13/74
Hazen Bay	6,800	Alaska	FWS	Delayed due to ANCSA
Hazy Islands	42	Alaska	FWS	Designated by Congress 10/23/70
High Sierra	10,000	California	FS	Under study[2]
High Uintas	323,000	Utah	FS	Transmitted to Congress 1/17/69
Huron Islands	105	Michigan	FWS	Designated by Congress 10/23/70
Idaho	1,225,000	Idaho	FS	Under study[2]
Imperial	12,010	Arizona-California	FWS	Transmitted to Congress 11/28/73
Indian Peaks		Colorado	FS	Suggested for study by Congress
Island Bay	20	Florida	FWS	Designated by Congress 10/23/70
Izembek	301,451	Alaska	FWS	Transmitted by Congress 4/28/71
Joshua Tree	372,700	California	NPS	Transmitted to Congress 11/28/73
Katmai	2,603,547	Alaska	NPS	Transmitted to Congress 6/13/74
Kenai	1,093,200	Alaska	FWS	Under study
Kings-Canyon Sequoia	750,690	California	NPS	Transmitted to Congress 6/13/74
Kodiak	1,815,000	Alaska	FWS	Delayed due to ANCSA

See footnotes at end of table.

Table 13—Continued

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated—Con.

Name	Acres[1]	Location	Sponsor	Status
Kofa	660,000	Arizona	FWS	Under study
Lacassine	31,776	Louisiana	FWS	Under study
Lake Mead	469,300	Arizona	NPS	Under study [2]
Lake Woodruff	18,412	Florida	FWS	Under study
Lassen Volcanic	78,982	California	NPS	Designated by Congress 10/19/72
Lava Beds	28,460	California	NPS	Designated by Congress 10/13/72
Lostwood	5,577	North Dakota	FWS	Under study
Lower Minam		Oregon	FS	Suggested for study by Congress
Malheur	30,000	Oregon	FWS	Transmitted to Congress 1/18/69
Mattamuskeet	50,179	North Carolina	FWS	Under study
Medicine Lake	31,457	Montana	FWS	Under study
Mesa Verde	8,100	Colorado	NPS	Transmitted to Congress 11/28/73
Michigan Islands	120	Michigan	FWS	Designated by Congress 10/23/70
Mille Lacs	0.6	Minnesota	FWS	Transmitted to Congress 6/13/74
Mingo	1,705	Missouri	FWS	Transmitted to Congress 11/28/73
Mission Mountain	73,000	Montana	FS	Transmitted to Congress 2/28/72
Missiquoi	620	Vermont	FWS	Transmitted to Congress 6/13/74
Monarch	25,000	California	FS	Under study
Monomoy	2,420	Massachusetts	FWS	Designated by Congress 10/23/70
Moosehorn	2,706	Maine	FWS	Designated by Congress 10/23/70
Mount Baldy	6,975	Arizona	FS	Designated by Congress 10/23/70
Mount Jefferson	99,600	Oregon	FS	Designated by Congress 10/2/68
Mount McKinley	1,939,492	Alaska	NPS	Under study [2]
Mount Rainier	202,200	Washington	NPS	Under study [2]
North Cascades	515,880	Washington	NPS	Transmitted to Congress 4/28/71
Noxubee	45,763	Mississippi	FWS	Under study
Nunivak	2,547,000	Alaska	FWS	Under study
Okefenokee	343,850	Georgia	FWS	Transmitted to Congress 4/28/71
Olympic	862,139	Washington	NPS	Transmitted to Congress 6/13/74
Oregon Dunes		Oregon	FS	Suggested for study by Congress

See footnotes at end of table.

Table 13—Continued

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated—Con.

Name	Acres[1]	Location	Sponsor	Status
Oregon Islands	21	Oregon	FWS	Designated by Congress 10/23/70
Organ Pipe Cactus	249,800	Arizona	NPS	Under study [2]
Parker River	4,649	Massachusetts	FWS	Under study
Pasayeten	505,524	Washington	FS	Designated by Congress 10/2/68
Passage Key	36	Florida	FWS	Designated by Congress 10/23/70
Pea Island	5,915	North Carolina	FWS	Under study
Pelican Island	6	Florida	FWS	Designated by Congress 10/23/70
Petrified Forest	50,260	Arizona	NPS	Designated by Congress 10/23/70
Pine Mountain	20,061	Arizona	FS	Designated by Congress 2/15/72
Pinnacles	10,980	California	NPS	Transmitted to Congress 6/13/74
Point Reyes	10,600	California	NPS	Transmitted to Congress 11/28/73
Popo Agie	71,000	Wyoming	FS	Under study [3]
Red Rock Lakes	32,350	Montana	FWS	Transmitted to Congress 6/13/74
Rice Lakes	1,406	Minnesota	FWS	Transmitted to Congress 6/13/74
Rocky Mountain	239,835	Colorado	NPS	Transmitted to Congress 6/13/74
Saguaro	42,400	Arizona	NPS	Transmitted to Congress 11/28/73
Saint Lazaria	65	Alaska	FWS	Designated by Congress 10/23/70
Saint Marks	17,740	Florida	FWS	Transmitted to Congress 9/21/72
Salmon River Break	217,000	Idaho	FS	Under study [3]
Salmon-Trinity Alps	223,000	California	FS	Under study [3]
Salt Creek	9,621	New Mexico	FWS	Designated by Congress 10/23/70
San Gabriel	36,137	California	FS	Designated by Congress 5/24/68
San Juan Island	168	Washington	FWS	Transmitted to Congress 6/13/74
San Rafael	142,722	California	FS	Designated by Congress 3/21/68
Santee	74,353	South Carolina	FWS	Under study
Sawtooth	216,383	Idaho	FS	Designated by Congress 8/22/72
Sawtooth		Idaho	FS	Suggested for study by Congress

See footnotes at end of table.

Table 13—Continued

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated—Con.

Name	Acres	Location	Spon-sor	Status
Scapegoat	239,295	Montana	FS	Designated by Congress 8/20/72
Semidi	256,000	Alaska	FWS	Transmitted to Congress 6/13/74
Seney	25,150	Michigan	FWS	Designated by Congress 10/23/70
Sheldon National Antelope Range	545,231	Nevada	FWS	Under study
Sheldon Refuge	34,131	Nevada	FWS	Under study
Shenandoah	73,280	Virginia	NPS	Transmitted to Congress 4/28/71
Simeonof	25,140	Alaska	FWS	Transmitted to Congress 4/28/71
Sleeping Bear Dunes	26,060	Michigan	NPS	Under study
Spanish Peaks	63,000	Montana	FS	Transmitted to Congress 2/8/72
Swanquarter	15,500	North Carloina	FWS	Under study
Sycamore Canyon	47,757	Arizona	FS	Designated by Congress 3/6/72
Tamarac	2,138	Minnesota	FWS	Transmitted to Congress 6/13/74
Theodore Roosevelt	28,335	North Dakota	NPS	Transmitted to Congress 9/21/72
Three Arch Rocks	17	Oregon	FWS	Designated by Congress 10/23/70
Tuxedni	6,402	Alaska	FWS	Designated by Congress 10/23/70
U.L. Bend	46,264	Montana	FWS	Under study
Uncompahgre	53,000	Colorado	FS	Under study [3]
Unimak	973,000	Alaska	FWS	Transmitted to Congress 6/13/74
Upper Mississippi	195,122	Iowa-Minnesota-Illinois-Wisconsin	FWS	Under study
Valentine	16,317	Nebraska	FWS	Transmitted to Congress 11/28/73
Ventana	95,152	California	FS	Designated by Congress 8/18/69
Voyageurs	219,431	Minnesota	NPS	Under study
Washakie	208,000	Wyoming	FS	Designated by Congress 10/9/72
Washington Islands	179	Washington	FWS	Designated by Congress 10/23/70
Weminuche	347,000	Colorado	FS	Transmitted to Congress 2/8/72
West Sister Island	85	Ohio	FWS	Transmitted to Congress 4/28/71
White River	975	Arkansas	FWS	Transmitted to Congress 11/28/73
Wichita Mountains	8,570	Oklahoma	FWS	Designated by Congress 10/23/70

See footnotes at end of table.

Table 13—Continued

National Wilderness Preservation System Act of 1964: Status of Areas Proposed, Studied, and Designated—Con.

Name	Acres	Location	Spon-sor	Status
Wilson Mountain	30,000	Colorado	FS	Under study [3]
Wisconsin Island	29	Wisconsin	FWS	Designated by Congress 10/23/70
Wolf Island	5,126	Georgia	FWS	Transmitted to Congress 2/8/72
Yellowstone	2,016,181	Wyoming	NPS	Transmitted to Congress 9/21/72
Yosemite	646,700	California	NPS	Transmitted to Congress 9/21/72
Zion	120,620	Utah	NPS	Transmitted to Congress 6/13/74

ANCSA—Alaska Native Claims Settlement Act.
FS—Forest Service.
FWS—Fish and Wildlife Service.
NPS—National Park Service.

[1] Sites under agency study list gross acreage, not wilderness area acreage.
[2] To be submitted to Congress by September 3, 1974.
[3] Further study requested to evaluate mineral resources.

Eastern Wilderness

As noted in last year's Annual Report, eastern wilderness has received increasing attention in recent years. Whereas large areas in the West have never been lumbered, farmed, or otherwise modified by man, few lands in the East have not been so modified. Consequently, although many lands have reverted to a wild condition, there has been a question as to whether they meet the definition contained in the Wilderness Act.

The Administration has proposed the Eastern Wilderness Amendment Act of 1973, introduced as H.R. 10469 and S. 2487. This proposal would amend the Wilderness Act to authorize wilderness designations in eastern National Forest lands, which have been modified in the past, but "where the imprint of man's work is substantially erased" and "which have generally reverted to a natural appearance." It designates 16 National Forest areas in the East for immediate inclusion and 37 areas to be studied for wilderness suitability. In contrast to the present Act, the proposed legislation prohibits—except for valid existing rights—mining, mineral leasing, and grazing. Pending Congressional action, the Forest Service is administratively protecting the potential wilderness areas identified in the Act.

Other approaches to eastern wilderness, initiated within Congress, are based on the premise that national forest areas in the East can be designated under the current law [269] without amending the definition. S. 3433 would designate 19 new wilderness areas and 40 study areas.

H.R. 1758 would designate 28 new wilderness areas in the National Forests of the East.

The large populations in the East and the growing desire for wilderness areas make it important that authority be established to designate wilderness in the eastern National Forests without delay.

Roadless Areas

The 187 million-acre National Forest System contains many roadless and undeveloped areas in addition to those now designated for wilderness protection. In 1967, the Forest Service initiated an inventory of these roadless areas for potential wilderness use. The inventory covered all roadless areas of 5,000 acres or larger, as well as smaller roadless areas contiguous to existing primitive areas or wilderness.[270]

During 1973, the review and evaluation of 1,449 roadless areas, covering 56 million acres, was completed. After public comment the Forest Service selected 274 areas containing 12.3 million acres for study as potential wilderness areas. Until the study is completed and designations decided upon, these new wilderness study areas will be protected from activity detrimental to their wilderness character.

The remaining 1,175 roadless areas will receive further consideration for wilderness potential during the Forest Service land use planning process. No development activity, including timber harvest, will be allowed without preparation of an environmental impact statement. In the preparation of such statements, wilderness designation will be one of the alternatives considered.

Wild and Scenic Rivers

The National Wild and Scenic River System was established in 1968.[271] The Act placed all or parts of eight rivers into the system, designated 27 other rivers for study as potential additions (with the studies to be completed by 1978), and established procedures to add additional rivers into the system.

All rivers in the system must be substantially free-flowing, have water of high quality, and possess outstanding scenic, recreation, geologic, fish and wildlife, historic, cultural, or similar values. The Act recognizes three categories of river: wild, scenic, and recreational. Wild rivers are the most primitive, difficult of access, unchanged, and fragile. Scenic rivers are free of impoundments and largely primitive and undeveloped, but can be accessible by roads and may have some recreational facilities. Recreational rivers are readily accessible by road or railroad. Although they may have some development along the shorelines and may have undergone some impoundment or diversion in the past, they provide particular recreational opportunities and are aesthetically pleasing.

During the past year, the Bureau of Outdoor Recreation conducted detailed studies on 28 rivers in Alaska. As a result of these studies, the Secretary of the Interior, in compliance with the Alaska Native Claims Act, has proposed adding 20 new units with a total of 2,753 miles of river to the National Wild and Scenic Rivers System. While 16 of these rivers lie within the boundaries of other proposed areas, four rivers with a total of 705 miles of river and 824,000 acres of adjacent lands would be established as separate units of the system.[272]

In August 1973, the Little Miami River was added to the system by the Secretary of the Interior pursuant to a request from the State of Ohio. Also during FY 1974, the Bureau forwarded to Congress reports on five rivers designated for study in the Wild and Scenic Rivers Act (Allegheny, Clarion, Little Miami, Lower St. Croix, and Suwannee), initiated field work on the Bruneau and Penobscot Rivers, and continued studies on the Buffalo, Gasconade, Little Beaver, Maumee, Pine, Rio Grande, Youghiogheny, Delaware, Missouri, and Obed Rivers.

On May 10, 1974, the President signed Public Law 93–279 authorizing designation and purchase of parts of the Chattooga River in North Carolina, South Carolina, and Georgia as a component of the National Wild and Scenic Rivers System.

National Scenic and Recreational Trails

The National Trails System Act of 1968 [273] established a further component of our Nation's natural heritage. The Act designated three categories of trails: scenic, recreational, and connecting or side trails.

Scenic trails are extended footpaths so located as to provide maximum outdoor recreation potential for the conservation and enjoyment of nationally significant scenic, historic, natural, or cultural qualities of the areas through which they pass. Scenic trails may be added to the system only by an Act of Congress. Two National Scenic Trails—the Appalachian Trail in the East under the administration of the National Park Service and the Pacific Crest Trail in the West under the administration of the Forest Service—were designated in the Act as initial components of the National System.

The Act designated 14 other trails for study to determine the feasibility and desirability of adding them to the system. Two of these studies have been completed: the Potomac Heritage Trail and the Continental Divide Trail. Six studies will be completed in FY 1975: the North Country Trail, the Oregon Trail, the Lewis and Clark Trail, the Mormon Battalion Trail, the Long Trail, and the Old Cattle Trail. Studies on the remaining trails are under way and scheduled for completion by FY 1976.

Recreational trails must be accessible to urban areas or within Federal or state parks, forests, or other recreation areas. They may be of

any length and designed for single or multiple purpose use, including use by motorized vehicles. They must remain as trails for at least 10 consecutive years after designation. Recreation trails, with connecting or side trails, are more numerous than scenic trails and are more available to urban populations. They may be added to the system by the Secretary of the Interior or the Secretary of Agriculture where lands administered by him are involved.

No money is authorized for National Recreation Trails in the Act. However, use of Land and Water Conservation Fund monies is encouraged. To date, 48 Recreation Trails have been designated by the two Secretaries for inclusion in the National Trails System.

An additional feature of the Act provides for coordination among Federal agencies whose jurisdiction covers abandoned railroad rights-of-way and their disposition. Such strips of land, traversing many private open space areas, are ideally suited for conversion into trail systems and bicycle pathways. These conversions of abandoned rights-of-way are being extensively studied by the Citizens Advisory Committee on Environmental Quality which will propose an overall recreation trail system to supplement the National Recreation Trails.

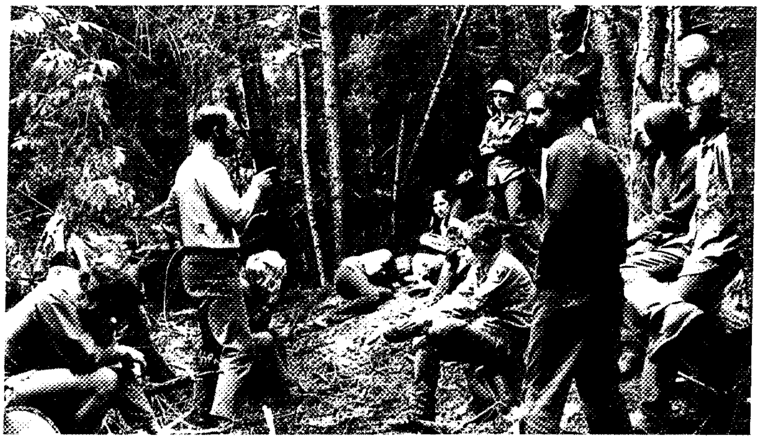
National Outdoor Recreation Plan

In December 1973, the President transmitted to Congress the Nation's first comprehensive outdoor recreation plan.[274] The plan was developed by the Bureau of Outdoor Recreation after extensive studies involving the public, recreation organizations, and Federal, state, and local governments.

The purpose of the plan is to guide all levels of government and private organizations in formulating policies and programs that are responsive to recreation needs of the people. The plan makes recommendations in three major areas: Federal actions to increase availability of recreation resources; Federal actions to improve management and administration of these resources and programs; and state, local and private actions to complement Federal recreation efforts.

Youth and Volunteers in the National Parks and National Forests

In recent years there has been a remarkable growth in programs designed to involve youth and volunteers with protection of our natural heritage. The Student Conservation Program (SCP) pioneered the concept in 1957 as a non-governmental endeavor, while Volunteers in Parks and the Youth Conservation Corps were started in 1970 pursuant to Federal legislation. These programs are primarily concerned with national parks, although the SCP also has had students in national forests and wildlife refuges. In the past year there



High School Wilderness Group of the Student Conservation Program in Cascades National Park. The youths in this program receive instruction and experience in various aspects of conservation while performing valuable work for the National Parks.

have been over 10,000 youths and volunteers in about 200 park units. The Volunteers in the National Forests program was initiated in 1972 under P.L. 92–300, and during the past year a total of 3,500 volunteers in the National Forest System contributed 200 man-years of work. In these programs the agencies benefit from help in conservation projects, visitor services, and research, while the youths and volunteers have healthy, satisfying summer employment and expand their knowledge of our natural and historic heritage through actual field experience. The process also enlarges the base of citizen understanding of the agencies' conservation activities.

Protection of the Coastal Zone

During the past year Federal actions to implement the Coastal Zone Management Act were begun. The nation's coastal zones contain some of our most critical ecological areas, many of which are extremely vulnerable to destruction. The coastal wetlands, for example, provide a critical link between the terrestrial and aquatic ecosystems and provide a vital service for the marine ecosystem. It is estimated that over 70 percent of all commercially valuable marine fishes rely on the estuarine areas during at least part of their lives. Half of the biological productivity of the world's oceans occurs along the coasts, and the estuaries are the most productive areas known on earth.

A study completed last year proposed an additional economic/en-

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vironmental perspective on the value of coastal wetlands, estimating that natural functions of tidal marshes—in cleaning air and water, providing nursery beds for marine organisms, producing nutrients for marine fisheries, buffering hurricanes, and in providing scenic and recreational values—is worth $85,000/acre/year compared to $1,000-$3,000 per acre if filled for urban use.[275]

Yet, coastal zones in general, and estuaries and tidal marshes in particular, are increasingly threatened by human activities. Land filling and development place great pressures on these areas. In the past 20 years, California alone has lost 67 percent of its coastal estuarine habitats in the process of coastal development.[276]

Careful protective management of our coastal zones is absolutely essential if we are not to continue to lose the natural heritage values of these critical areas, including the commercial and sport fisheries that depend upon them. Implementation of the Coastal Zone Management Act should contribute significantly to the protection of these values. The land use planning required by this Act is discussed in Chapter 1 on Land Use.

Ecological Reserves

Human activity modified the varied ecosystems found in North America prior to European settlement. Most of the original ecosystems remain only as relics, and some are gone entirely. In recent years there has been increasing recognition of the importance of preserving representative samples of these natural ecosystems, to serve as baselines or ecological benchmarks by which we may better understand the changes that have taken place elsewhere, to serve as field laboratories where the natural ecological processes may be studied and understood, and to serve as banks or "gene pools" to preserve irreplaceable genetic and ecologic diversity.

Several Federal agencies have made efforts to establish natural areas on Federal lands.[277] There were also various efforts at local, state, and national levels to inventory and establish reserves. However, there was no coordinated Federal program to bring the individual efforts into a comprehensive national system. During the past year, the Committee on Ecological Research of CEQ and the Federal Council on Science and Technology recommended completion of a national system of ecological reserves to include both protected Research Natural Areas and related experimental sites.[278] In July 1974, the Chairman of CEQ and the President's Science Advisor, noting that "an adequate system of ecological reserves . . . is essential to attainment of national environmental and land use goals as well as to the basic health of ecological and environmental sciences," [279] established an interagency program to develop a National System of Ecological Reserves.

Forestland Resources

Balanced Forest Management

In recent years there has been increasing public as well as governmental recognition and attention to the multiple values of forest lands such as water, forage, wildlife, timber, and recreation. Many conservationists believe that timber resources, especially within National Forests, receive too much attention at the expense of other land values. Others, particularly in the timber and home building industry, have argued that concern with non-timber uses is interfering with proper attention to timber production. These concerns have been heightened by increased prices of wood products and projections of timber shortages.

The most recent projection of the timber supply and demand situation is the Forest Service report, *The Outlook for Timber in the United States,* released in October 1973.[280] The report provides an analysis of the Nation's timber situation as of 1970 and the outlook for the future based on different economic and management assumptions. The report points out that demand for industrial timber products increased 65 percent over the 3-year period, 1968–70. Using mid-range assumptions, the Forest Service analysis indicated that at 1970 comparative price levels, demand for timber for industrial uses would double from 12.7 billion cubic feet in 1970 to 23 billion cubic feet by 2000. With higher relative prices of timber products, the analysis still predicted a demand of 19 billion cubic feet. At the same time, with management practices at the 1970 level, supplies of timber products would not increase sufficiently to meet these demands. The deficiencies would be most significant for softwoods and high quality hardwoods.

Concern stemming from this type of assessment led to the appointment of the President's Advisory Panel on Timber and the Environment. In a report submitted in April 1973,[281] the Panel concluded that increased timber production was possible and desirable from some of the public lands, but stressed the importance of adequate environmental safeguards. The Panel said that timber supplies can be increased through better management (especially on private forest lands and wood lots), through less wastage of wood in the forest and in manufacturing, and through recycling of wood wastes. Many of these practices can lessen adverse environmental effects of timber harvesting. However, some practices, such as control of competing vegetation, may have undesirable effects on other forest resources such as wildlife. In order to meet the predicted needs, the President's Panel recommended an increased annual Federal expenditure on the order of $200 million for forest development.

In an effort to further balanced and effective management of forest lands, the Forest Service in 1973 replaced its former emphasis on functional areas, such as timber management, with a new orientation

toward land use planning and land use management. Functional or resource plans are now oriented to accomplish the objectives of land use plans, and public participation in the development of goals and objectives is stressed.

Over the past year, the Forest Service developed guidance documents for many large areas such as New England and the coastal plains, and prepared plans for individual forests and smaller units. NEPA requirements, including preparation of environmental statements, were integrated into the unit plans. (See Chapter 4.) The use of interdisciplinary teams was broadened, and several computer programs were developed to expand the ability of the Forest Service to explore more thoroughly the cause and effect relationships of a broader range of alternatives.

Mining Regulations in National Forests

In 1974, the Department of Agriculture promulgated its first regulations governing surface use of National Forest lands by persons operating under the 1872 mining laws.[282] These laws have served to encourage prospecting and mining on the public domain lands, but they have done so at considerable cost to the local environment. Until this year prospecting and mining were the only resource activity not regulated in the National Forests.

The new regulations comply with the requirements of NEPA. They are intended to provide for reasonable protection of surface resources and the environment, while at the same time encouraging the minerals industry in responsible use of National Forest lands for the benefit of the national economy.

Timber on Private Land

Over three-fifths of America's potentially productive timberland is in private ownership. Most of it is in small tracts and presently not very productive of commercial timber. But these lands represent a potential timber resource of enormous value and significance to the United States. The problem has been one of how to provide adequate incentives for the private owners of these small tracts to increase their timber production.

In August 1973, the Agriculture and Consumer Protection Act of 1973 was enacted.[283] This law authorizes a forestry incentives program designed to encourage owners of small tracts of forest lands to plant trees and to improve the productivity of their forests through thinning and other practices. Within months, the U.S. Department of Agriculture and state and local agencies had the program of cost-sharing and technical assistance in progress. This Act also authorizes cost-sharing and technical assistance for a wide variety of other con-

servation practices of interest to farmers and other landowners, such as soil stability, watershed capacity, aesthetic values, and improvements in wildlife habitat and recreation opportunities.

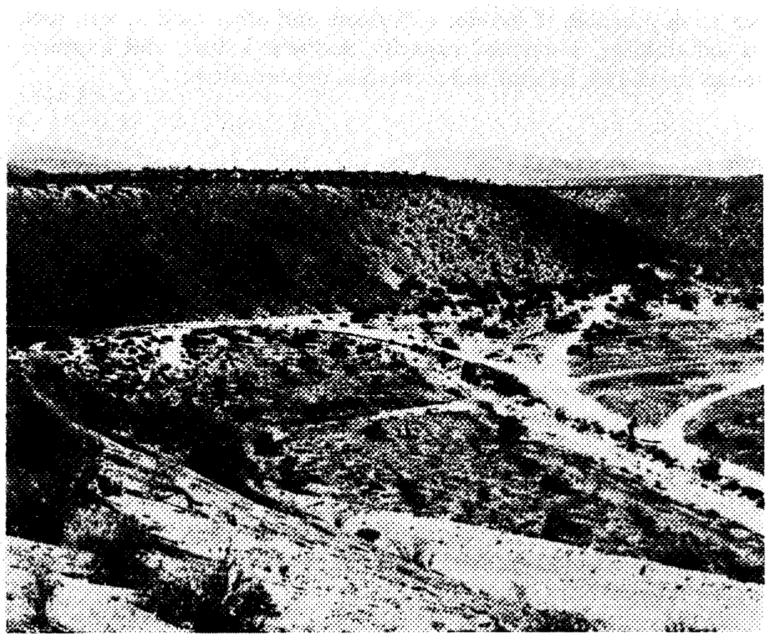
Off-Road Vehicles

In 1972, President Nixon issued Executive Order 11644, to control the use of off-road vehicles (ORV) on public lands. Total numbers of ORVs and their use on public lands were growing dramatically. While they have legitimate uses, ORVs also have a particular potential for destroying fragile wild lands, damaging wildlife and other wilderness values, and disturbing other users of the public lands. The Executive Order required the agencies which manage Federal lands to develop regulations for ORV usage, aimed at lessening damage to wildlife and other natural resources and minimizing conflicts with other recreational uses. The agencies were to designate areas where the ORVs may and may not be used and to specify operation conditions. During the past year the agencies have issued the required regulations, but they are only the first small step in providing the necessary controls.

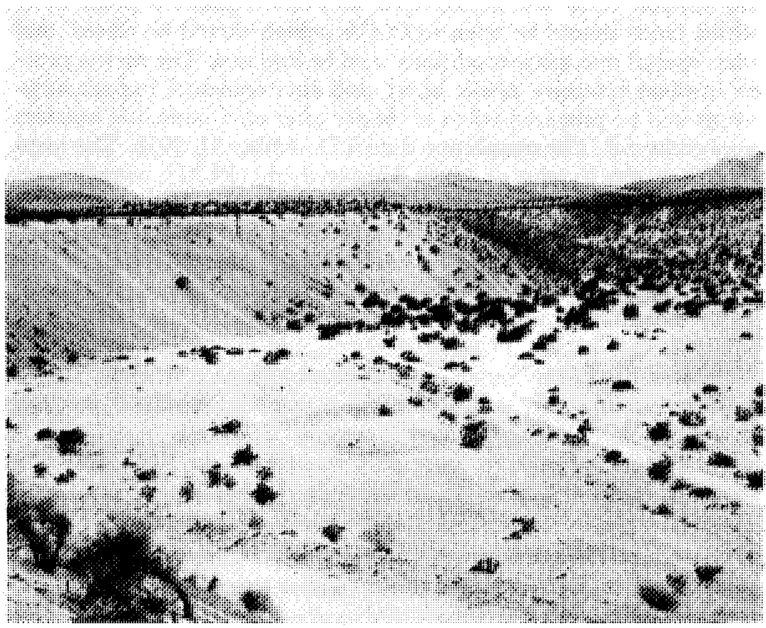
Under existing policies of the National Park Service and the Fish and Wildlife Service, ORV use is prohibited or strictly limited on much of the 60 million acres under their control. Consequently, their new ORV regulations essentially maintain the status quo.

The regulations of the Forest Service set conditions under which its 187 million acres will be surveyed and determinations made as to which lands should be open to ORVs, which should be closed, and what special operating conditions need be imposed. The review process involves extensive public input, and environmental impact statements will be prepared when necessary after environmental analyses are conducted. The completion date is December 31, 1976. The regulations of the Bureau of Land Management (BLM), which is responsible for some 450 million acres of public land, are procedurally similar. But because of the vast area involved and limitations on personnel and funding, the date for completion of the survey and delimitation of BLM lands is December 31, 1979. Consequently, although some critical areas will receive protection, much of this vast area of public land may remain largely unprotected for another 2 years in the case of the Forest Service and 5 years in the case of BLM. Hence there is potential for serious damage to wildland resources through misuse of ORVs before the final process is completed.

ORV use continues to grow at a rapid rate. In 1959, only 259 snowmobiles were sold in North America; by last year, the number in use had grown to over 2 million.[284] Between 1960 and 1970, sales of motorbikes and motorcycles increased from 60,000 to over 1.5 million a year. Over 200,000 dune buggies are now in use. Taken together, more than 5 million ORVs are in operation in the United



Habitat destruction by ORVs, near Bakersfield, California. Top photo, taken in 1968, already shows damage from motorcycles. By 1972, use of ORVs had destroyed most vegetation and soil surface.

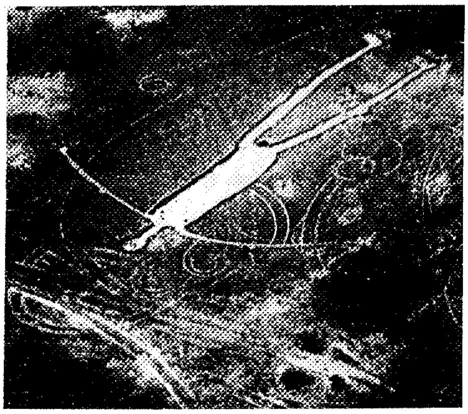


States today.[285] Despite the rapid growth in ORV sales and use, the percentage of the public using ORVs remains relatively small, but the damage they do is out of all proportion to their numbers.

When misused, ORVs damage soil and destroy vegetation, disturb wildlife, destroy wildlife habitat, bring noise, litter and vandalism to previously remote areas, and seriously disrupt other types of recreation. Both deliberately and inadvertently, ORV drivers have destroyed scientific areas, historical and archeological sites, and private property.[286] Use of ORVs is most destructive in ecologically fragile areas, such as high alpine zones, steep slopes, coastal and sand dunes, and arid lands. The problems are currently most serious in the arid lands. The Committee on Arid Lands of the American Association for the Advancement of Science reported in April 1974 that the recreational pressure being exerted upon the desert resources of southern California, which "is growing by leaps and bounds," is "almost completely uncontrolled," and has brought great destruction. The AAAS Committee concluded that present unregulated ORV use of arid lands is a serious threat to the preservation of the environment in a desirable and stable condition.[287]

The past year has seen progress at the Federal level toward regulating and controlling the use of ORVs. But the problem is still growing at an unprecedented rate, and virtually no effective new controls have as yet been accomplished. Citizen concern with problems caused by ORVs has grown so intense during the past year that a bimonthly report on the status of the issue (*ORV Monitor*) is now being published.[288]

The problem is not limited to the United States. Snowmobile use is permitted in Ontario under existing legislation.[289] However, after 12 months of study, a Select Committee of the Ontario Provincial Government concluded that ORVs represent a potential menace and recommended tight controls over their use. The principal recommendation was that all-terrain vehicles should be generally banned from recreation, picnic, wildlife, and camp areas, and that municipal-



This figure is a 175-foot prehistoric art form cut into the desert floor by ancient Indians. Damaging ORV tracks show clearly.

ities should have the right to ban such vehicles when they are considered a hazard to the environment or to the health and enjoyment of people using recreation areas.

Conclusion

In his State of the Union Message in January 1974, President Nixon stated that our Nation has entered "the second phase of environmental action." He said further,

> In this second phase, we will be looking at our environmental problems in new ways which are more complex and far-reaching than those to which we have become accustomed. We must be concerned not only with clean air, clean water and wise land use but also with the interaction of these environmental efforts with our need to expand our energy supplies and to maintain general prosperity.
>
> In facing up to these tough, new problems, we can draw strength from the progress we have already made and from the knowledge that there can be no turning back from our general commitment to preserve and enhance the environment in which we live.

This chapter has presented the major events of the past year. The primary theme is the manifold interrelationships of energy and environmental policy. The secondary theme is the continued implementation of the environmental initiatives of the past five years. The chapter documents both the challenging complexities of "this second phase of environmental action" and the strength of our national commitment to the continued pursuit of environmental quality.

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APPENDIX 1

Calculating Abatement Costs

The CEQ abatement cost estimates are based primarily on information provided by EPA and by other Federal agencies. This information is processed and, where necessary, supplemented, in order to provide consistent estimates of total and incremental costs. In all those calculations where a range of reasonable cost estimates was available, the higher estimates were used in order to be conservative.

Total Costs

The calculations begin with an estimate of "total" pollution abatement costs (see Table 1). These estimates include all expenditures reasonably allocated to collecting and treating wastes to prevent them from degrading the environment. For example, they include collecting and disposing of solid wastes, all the costs of installing and maintaining sewers, building and operating waste water treatment plants, etc. For most industrial processes these estimates predominantly assume the installation of "end-of-the-pipe" pollution control equipment to treat the entire waste flow produced by the industry. This assumption ignores the potential for changes in production processes, such as the recycling of process waters, which reduce the amount of wastes generated at a lower cost than would be required to treat them. For this reason the CEQ estimates tend to be higher than actual costs, particularly in terms of capital requirements.

Incremental Costs

The incremental cost estimates attempt to identify those costs which can be attributed to Federal environmental legislation enacted since 1965. These costs are calculated by subtracting a CEQ estimate of baseline expenditures—expenditures that would have been made even in the absence of the Federal legislation—from the total cost estimates. The "baseline estimates" are constructed on the basis of expenditure trends which were in evidence before the Federal legislation began to be implemented.

A good example of the difference between total costs and incremental costs is provided by the solid waste cost estimates. The total costs, as stated above, include all the costs of collecting and disposing of these wastes. Few of these costs, however, can reasonably be attributed to Federal legislation; the wastes

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would have to be collected and disposed of regardless. The "incremental" solid wastes costs, therefore, are those associated with (1) increased amounts of solid wastes that must be collected as a result of prohibitions on backyard burning or incineration without adequate air pollution controls, and (2) increased disposal costs associated with efforts to eliminate air and water pollutants (e.g., the conversion of "open dumps" to sanitary landfills). For solid wastes the incremental costs are very small compared to the total costs. In other instances, such as industrial water pollution abatement, incremental costs approach total costs because little abatement is expected to have occurred in the absence of Federal legislation.

In general, the CEQ "baseline" estimates are probably low. As a result, the incremental cost estimates are probably on the high side.

Capital, O&M, and Annual Costs

All calculations are initially based on estimates of (1) the value of pollution control equipment in place before the Federal legislation went into effect plus (2) the value of investments made subsequently and projected over the next decade. All capital is valued in terms of its replacement cost in 1973.

These "capital-in-place" estimates are then used to calculate "capital costs," "operating and maintenance expenditures," and "annual costs." The capital costs are calculated by amortizing the capital-in-place over its economic life at a discount rate that approximates long-term borrowing rates. Thus the capital cost figures include depreciation of capital plus financing costs, implicitly assuming that all capital equipment is financed by borrowing.

Operating and maintenance costs are assumed to be a fixed percentage of the value of capital in place, a percentage which differs, of course, for different abatement techniques and for different industries.

Annual costs are the sum of the annual capital costs and the annual operating and maintenance costs described in the two preceding paragraphs.

Some Problems

Any cost projections such as those undertaken by the CEQ are necessarily very uncertain. The magnitude of the uncertainty is aptly demonstrated by changes in these estimates from one year to the next. Some of these changes are attributable to inflation. The 1974 estimates are all based on 1973 prices whereas the 1973 estimates were based on 1972 prices. However, more substantial changes usually result from revised estimates of how much equipment will be required and how much this equipment actually costs. For instance, the 1974 total cost estimates are 18 percent higher than the equivalent 1973 estimates. Approximately one-fourth of the 18 percent cost increase is attributable to inflation. Anther one-half results from changing the estimating period from 1972–81 to 1973–82, and the remainder represents a net increase in real costs.

The present estimates still contain other recognized uncertainties. In some instances, final pollution control regulations may not have been issued, leaving great uncertainty regarding the techniques that will have to be adopted to satisfy these regulations. The most significant instance of this difficulty is with the 1983 "best available technology" standard established by the 1972 Amendments to the Federal Water Pollution Control Act. Although every reasonable effort was made to include some estimates of the additional costs associated with the 1983 standards, in many industries the required technology has not yet been defined, and the costs of meeting the 1983 standards could not be included in this year's estimates.

A similar type of problem exists in regard to new pollution abatement technologies and whether new and less expensive technologies will be developed

Table 1

Estimated Total Pollution Control Expenditures

[In billions of 1973 dollars]

Pollutant/medium	1973			1982			Cumulative—1973–82		
	O&M [1]	Capital costs [2]	Total annual costs [3]	O&M [1]	Capital costs [2]	Total annual costs [3]	Capital invest-ment	O&M [1]	Total annual costs [3]
Air pollution									
Public	0.1	0.1	0.2	0.5	0.2	0.7	1.7	3.8	5.4
Private									
Mobile	1.2	0.2	1.4	8.4	4.9	13.3	31.3	49.9	74.4
Stationary	1.1	1.1	2.2	4.7	3.1	7.9	21.4	35.3	62.6
Total	**2.4**	**1.4**	**3.8**	**13.6**	**8.2**	**21.9**	**54.4**	**89.0**	**142.4**
Water pollution									
Public									
Federal	0.2	NA	NA	0.2	NA	NA	1.8	NA	NA
State and local	1.4	4.1	5.4	4.2	8.3	12.5	50.6	27.4	88.5
Private									
Industrial	0.9	1.1	2.0	2.8	2.2	5.0	16.5	21.6	40.4
Utilities	NA	NA	0.01	0.4	0.3	0.7	4.4	2.2	3.5
Total	**2.5**	**5.2**	**7.4**	**7.6**	**10.8**	**18.2**	**73.3**	**51.2**	**132.4**
Noise	NA	0.1	NA	NA	1.0–1.4	NA	6.0–8.7	NA	NA
Radiation									
Nuclear powerplants	NA	NA	NA	<0.05	0.05	0.07	0.3	0.08	0.3
Solid waste									
Public	1.1	0.3	1.4	1.9	0.5	2.4	4.2	15.5	19.3
Private	1.9	<0.05	1.9	3.0	0.1	3.1	0.4	25.2	25.6
Total	**3.0**	**0.3**	**3.3**	**4.9**	**0.6**	**5.5**	**4.6**	**40.7**	**44.9**
Land reclamation									
Surface mining [4]	0.3	0	0.3	0.6	0	0.6	0	5.0	5.0
Grand total [5]	**8.2**	**6.9**	**14.8**	**26.7**	**19.7**	**46.3**	**132.6**	**185.9**	**325.0**

[1] Operating and maintenance costs.
[2] Interest and depreciation.
[3] O&M plus capital costs.
[4] Includes only coal mining.
[5] Does not include noise control.

in the near future. This problem is particularly serious for the mobile sources cost estimates. These estimates are all based on the assumption that the catalytic converter with its fuel penalties will remain the sole abatement technique through the beginning of the next decade, a conservative assumption that may result in a substantial overstatement of costs. The adoption of other existing technologies could make the actual costs much less.

Beyond these information problems there are also some problems inherent in the estimating methodology which tend to result in overestimates or underestimates of the real costs. One of these is the assumption underlying the total cost estimates that most abatement will be accomplished by "end-of-the-pipe" treatment. In many instances, process changes or a combination of process changes and end-of-the-pipe treatment will be more economical. Adopting process changes tends to decrease capital costs requirements, but may increase operating and maintenance costs moderately.

This probable overstatement of total costs, combined with a likely underestimate of baseline expenditures, results in a greater tendency to overstate incremental costs.

Finally, the selection of the discount rates to be used in amortizing capital capital costs affects the annual cost estimates. In general, a rate of 8 percent has been used for private investments (10 percent for mobile sources) and 6 percent for public investments. Both rates are probably below the economist's estimate of the "opportunity cost" of investment funds, and both are below interest rates experienced during the past year. Using these rates tends to understate the financial cost of investments made during such high interest rate periods, but are not unreasonable estimates for longer-term average rates. Also not all investments are financed by borrowing, so that the assumption that they all are, which underlies the total cost analysis, tends to overstate the financial costs.

Estimates in Specific Sectors

Air Pollution

The air pollution abatement cost estimates are based primarily on information provided in the 1973 edition of *The Cost of Clean Air,*[1] which contains substantially higher cost estimates than previous editions. Cost estimates for the years 1980, 1981, and 1982, were undertaken directly by the CEQ.

Mobile Sources—The major source of air pollution in this category is the private automobile. Estimating automobile abatement costs involves projecting new car sales, the total number of automobiles operating with control devices, the number of miles they are driven, their average fuel economy, and the price of gasoline.[2] These projections are combined with EPA estimates of the initial and maintenance costs of pollution devices, and the fuel penalty which results from their use.[3]

Investment estimates are the product of the per vehicle costs for the pollution control device required in any year times the projected number of new car sales. This investment (including the replacement catalyst) is assumed to depreciate evenly over a 10-year average vehicle life. This assumption and a 10 percent interest rate are used to calculate capital costs. Maintenance costs are assumed constant over the life of the vehicle. Increased operating costs are those attributable to lower gas mileage resulting from the anti-pollution devices.

Investment and operating and maintenance costs for mobile sources other than private autos were taken from EPA's 1974 *The Cost of Clean Air.* Since the magnitudes of these figures are small relative to investment in automobiles, it is assumed that investment is evenly distributed over the period. This assumption is different from that employed in *The Cost of Clean Air* but does not significantly influence mobile source costs.

The costs of controlling pollution from all mobile sources is assumed to be entirely attributable to Federal regulations. Therefore, incremental costs equal total costs.

Stationary Sources—Investments for abating air pollution from stationary sources, including steam electric plants, are assumed to peak in 1975 in order to meet 1977 pollution standards. This year's estimated costs are significantly higher than they were last year because of the revised EPA estimates.

The economic life of these investments and the ratio of O&M costs to capital-in-place varies for different abatement techniques and for different industries. The assumptions made in the 1974 edition of *The Cost of Clean Air* were used in these calculations as well.[4]

In calculating incremental costs, the baseline expenditures were taken from a special study of the pollution control equipment industry and adjusted to reflect 1973 prices.[5]

Public Sources—These estimates for solid waste and sewage sludge incinerators were taken directly from *The Cost of Clean Air*.[6] Equipment was assumed to have a 15- to 16-year economic life, and a 6 percent discount rate was used in estimating annualized capital costs. Incremental costs are assumed equal to total costs.

Water Pollution Abatement

Industrial Sources—The cost estimates for water pollution abatement by industry are based primarily on the 1973 EPA report, *The Economics of Clean Water*.[7] Water pollution abatement from feedlots is included in the industrial cost estimates. A water use scenario (numbered 3 in The *Economics of Clean Water*) which assumes that the water use efficiency of the 8 least efficient regions increases to half way between their 1968 efficiency and the median regional efficiency in 1968 has been used in estimating these costs. In general, the more efficient the use of water, the lower the abatement costs.

Investments in water pollution abatement are distributed over the decade similarly to those in a 1972 EPA study,[8] and annual investment is extrapolated from 1979 through 1982 using assumptions similar to those in *The Economics of Clean Water*. Where reasonable data were available, these cost estimates are adjusted to reflect the additional costs required by the 1983 "best available technology" standards in addition to the 1977 "best practicable technology" standards. However, such adjustments could not be made for most industries.

To compute annualized capital costs, a 20-year economic life and an 8 percent discount rate were used. Annual operating and maintenance costs are estimated to be 12.5 percent of investment in place.

For the incremental cost estimates, the baseline estimate is taken from a 1972 study of the pollution control equipment industry after adjusting for inflation.[9]

Utilities—The cost of abating thermal water pollution from utilities is based on estimates supplied by EPA subsequent to the preparation of *The Economics of Clean Water*. These estimates assume some exemption of facilities from meeting the standards where thermal pollution is not a significant problem.[10]

Investment is distributed over the decade assuming that it will be a relatively smooth curve with peaks in 1975 and 1982.

In computing annualized capital costs, a 20-year economic life and 8 percent discount rate were used. Operating and maintenance costs are assumed to be 22 percent of the value of capital in place.[11] Incremental costs are assumed equal to total costs.

Public Facilities—The limited amount of information on the costs of abating water pollution from Federal facilities was provided by EPA.[12]

For municipal sewers and sewage treatment plants, the cost estimates are based on estimates of Federal disbursements required to satisfy the standards established by the 1972 Amendments to the Federal Water Pollution Control Act.[13] This stream of Federal expenditures is then adjusted to include the state and local share of federally funded facilities, municipal sewers that are not partially funded by the Federal Government, and sewers installed by private developers.[14]

An economic life of 25 years and a discount rate of 6 percent were used to calculate annualized capital costs. The estimate of operation and maintenance costs required an assumption about the relative proportion of investment allocated to different types of treatment plants, since each has its own ratio of operating and maintenance costs to investment costs.[15]

In calculating incremental costs, the trend in investments from 1958 to 1965 was extrapolated on the basis of increased population served by municipal plants and increased sewage flow per capita.[16] This definition of the baseline is similar to, but less than, that obtained by a simple extrapolation of per capita or total expenditure trends prior to 1965. The baseline estimates also assumed that a lower proportion of secondary and tertiary treatment plants would be built, thus lowering the ratio of operating and maintenance costs to capital-in-place.

Noise

The estimated noise control costs include modifications to commercial aircraft, trucks, and trains. All estimates are based directly on EPA and Department of Transportation studies.[17] Incremental costs are assumed equal to total costs.

Radiation

The estimated costs of radiation control from nuclear power plants include only the additional costs for equipment required to treat air and water effluents in order to reduce radiation emissions below the original AEC standards. The cost estimates were provided by the Atomic Energy Commission and are assumed to represent both incremental and total costs.[18]

Solid Wastes

The solid waste cost estimates were based on EPA estimates of per capita waste generation and unit cost estimates for collection and disposal,[19] and CEQ estimates of the relative importance of different disposal methods and the proportion of total wastes which are actually collected and disposed of by either private or public enterprises. These total cost estimates are then allocated between the public and private sector, assuming that two-thirds of residential and commercial wastes and 90 percent of industrial wastes are collected by private firms, and 10 percent of the former and all of the latter are disposed of privately.[20]

In calculating incremental costs, it was assumed that a smaller proportion of wastes would be collected, and disposal costs would be lower (assuming greater use of open dumps) under the baseline case.

Land Reclamation

The land reclamation cost estimates are limited to the reclamation of new strip-mined coal, and are based on CEQ cost analyses.[21] Unit reclamation

cost figures of $0.10 per ton of coal mined in the West and $1.00 per ton of coal mined in the East are applied to recent Department of the Interior projections of U.S. coal production.[22] Incremental costs are assumed equal to total costs.

References

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6. EPA, *The Cost of Clean Air, supra* note 1, pp. IV–136 to IV–144.
7. EPA, *The Economics of Clean Water* (1973) p. 43.
8. Arthur D. Little, *supra* note 5, at 110.
9. *Id.*, p. 108.
10. Estimates received from the Environmental Protection Agency, Office of Economic Analysis, on the basis of final effluent guidelines issued by the Administrator on October 2, 1974.
11. Based on information received from Environmental Protection Agency, Office of Economic Analysis.
12. *Id.*
13. *Id.*
14. State and local expenditures equal one-third of Federal expenditures. Private expenditures on sewers are expected to continue the trend established during the past 5 years.
15. EPA, *Cost to the Consumer for Collection and Treatment of Wastewater* (1970).
16. Arthur D. Little, *supra* note 5, p. 97.
17. EPA, *Report of Aircraft-Airport Noise* (1973).
18. Letter to Stephen Phillips from George P. Eysymontt, Office of Planning and Analysis, Atomic Energy Commission, July 5, 1974.
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20. National Solid Waste Management Association, *Technical Bulletin*, Vol. 3, no. 10 (November 1972).
21. EPA, *Coal Surface Mining and Reclamation* (1973).
22. Walter G. Dupree, Jr. and James A. West, *United States Energy Through* the Year 2000 (Washington: U.S. Department of the Interior, 1972), p. 10.

APPENDIX 2

Capital Expenditures by Business for Air and Water Pollution Abatement, 1973 and Planned 1974*

In 1973, nonfarm business spent $4.9 billion for air and water pollution abatement plant and equipment; it plans to spend $6.5 billion in 1974, according to a BEA survey conducted in November and December 1973.[1] Most spending and planned spending is for the improvement of air quality: 64 percent in 1973 and 66 percent planned for 1974. Five industries accounted for $3.3 billion, or 66 percent, of the 1973 total: electric utilities ($1.4 billion), petroleum ($0.6 billion), nonferrous metals ($0.5 billion), chemical ($0.4 billion), and paper ($0.4 billion). Four industries spent 10 percent or more of their capital budgets for air and water pollution abatement: nonferrous metals (31 percent), paper (19 percent), blast furnace, steel works (16 percent), and petroleum (10 percent). Four industries plan to increase their capital spending 50 percent or more in 1974: stone, clay, and glass (96 percent), petroleum (67 percent), blast furnace, steel works (66 percent), and food including beverage (51 percent). Aircraft equipment manufacturing and air transportation are the only industries that plan decreases.

Twenty-one percent of businesses responding had capital expenditures for air or water pollution abatement. Businesses with such expenditures had total new plant and equipment expenditures of $56 billion, which is 56 percent of the total estimated investment in 1973.

Another conclusion suggested by the survey is that pollution regulations have not reduced plant and equipment expenditures.

Questions on capital spending for air and water pollution abatement were added to BEA's annual Plant and Equipment Expenditures Survey form. Future surveys may be expanded to include other forms of pollution. The types of questions asked and the definitions of what constitutes pollution abatement expenditures (PAE) were more precise than those used in similar surveys conducted by trade associations and other private organizations. Survey responses were received after the announcements of the Arab oil embargo; the extent to which capital PAE budgets had been changed because of the

*Excerpts from an article by John E. Cremeans, *Survey of Current Business*, July 1974, pp. 58–64. The author notes: "The estimates were prepared by John T. Woodward. Significant contributions to this study were made by Frank W. Segel, William B. Sullivan, and Gary L. Rutledge."

Pollution Abatement Expenditures and the National Economic Accounts

Widespread concern for the environment has led to significant levels of private and public spending for pollution abatement. BEA has begun a comprehensive program to estimate these expenditures within the framework of the national economic accounts. The estimates, which will cover expenditures by consumers, business, and government, will be prepared from existing and new data sources.

The national accounts provide a consistent conceptual and statistical framework for estimating pollution abatement expenditures (PAE). Also use of this framework ensures comparability between PAE and other components of the accounts. Such comparability is essential to the analysis of the effects of PAE on the economy, which is conducted primarily with the aid of the accounts.

The relationship between PAE and the accounts has been extensively discussed, as have ways to compile new economic measures that will permit better analyses of pollution abatement programs and their economic effects. (See, for example, *Survey of Current Business*, Anniversary Issue, July 1971, pp. 221–25.)

The treatment of PAE in the GNP is identical to that of corresponding expenditures for other purposes: consumer expenditures for pollution abatement materials or services are included in personal consumption expenditure and government PAE are included in government purchases of goods and services. However, neither can be separately identified. Although the treatment of business PAE is also the same as that of other business expenditures, it is worthy of special note. The current operating expenses of the abatement activities of business are not included in GNP because they are not final products, but they increase the costs of these products and may lead to price increases. GNP in constant dollars will fall as PAE increases unless new resources are employed or productivity increases.

Business expenditures for capital goods for abatement are counted as gross private domestic investment in the year in which they occur. However, the effect on GNP in the years that an abatement good is in service differs from that of an ordinary capital good. In its years of service, an ordinary capital good produces a stream of services whose dollar value enters into the calculation of GNP. The stream of services produced by an abatement good does not, because it has no market value.

Both current and capital PAE will be estimated by BEA. This will make it possible to identify PAE now included in GNP and to take into account PAE not now included. It will make it possible also to deduct from GNP, PAE now included—an alternative that is preferred by some.

The following article reports the results of a survey of capital expenditures for air and water pollution abatement by nonfarm business, which was conducted by BEA as part of its environmental program. It is the first such survey conducted by the Federal Government.

embargo is not known. A survey in January 1974 indicated that overall capital budgets were not affected significantly by energy shortages. (See *Survey of Current Business,* April 1974, pp. 46–47.)

Problems in the Definition and Collection of PAE Data

The desirability of PAE data is clear, but important conceptual problems must be resolved if useful and consistent results are to be obtained. Although "pollution" and "pollution abatement" are familiar words, there are no precise and generally accepted definitions of PAE. Business does not know exactly what portion of its expenditures should be included in PAE, and indeed, environmental authorities do not always agree on definitions. Five definitional problems are outlined here; several of them are taken up again in the discussion of the questionnaire.[2]

The first problem is referred to as the baseline problem. It has often been suggested that PAE should be measured from a baseline that is defined by zero expenditures for environmental protection. Some forms of pollution abatement have been practiced for many decades—long before the current surge in interest and legislation. If a "zero pollution abatement" accounting base is desired, many longstanding production methods would have to be excluded from the base (and included in PAE) even though some of them have production advantages.

BEA's approach to this problem has been to consider the base as being the minimum cost method that would be chosen if the designer were indifferent to pollution emissions. In some cases, the design adopted may result in more pollution than its alternatives; in other cases, the minimum cost method may result in less pollution. The crucial point is that the basis for choosing a method includes only considerations of cost and does not require analysis of pollutants. In practice, many recently developed processes are both cleaner and less costly. For example, a major segment of the paper industry has shifted from the sulfite to the sulfate process because it is more efficient. The fact that the sulfate process is also less polluting is a benefit, but its cost should not be charged to pollution abatement.

The second problem is that of joint costs, which arise because many abatement techniques also increase production or have valuable byproducts. They also occur when a new process is designed to achieve certain emission standards. It is difficult to estimate how much of the total cost should be charged to abatement and how much to normal expenditures. This problem is expected to become more significant as new plants are built and new equipment is designed that incorporate abatement techniques and devices. Again, the rule should be that PAE is estimated as the total cost of the unit less the estimated cost of a similar unit designed and built without consideration for pollution control. Thus, expenditures for units and processes, such as the sulfate paper process, that are on balance more productive than their polluting counterparts, would not be classified as PAE.

The third problem concerns the treatment of capital goods bought to produce goods and services sold to others to reduce pollution in their operations. Such capital goods are not counted as PAE in this survey. For example, when an oil company installs special equipment to remove sulfur from oil, this equipment is not included in PAE even though it reduces pollution in the operations of the users of the low-sulfur oil.

The fourth problem arises from the fact that some expenditures made as a result of pollution abatement decisions are not recognized as such by those who make them. For example, if strip mining were to be banned for environmental reasons, the incremental costs of opening and operating deep mines or of providing substitute fuels would generally not be recognized as PAE by those controlling the actual expenditures. The survey described in this article does not, of course, capture this kind of unconscious expenditure.

The fifth problem involves the need to separate PAE from expenditures for other related purposes. For example, dust collectors or filtering systems intended to improve air quality within a plant are properly charged to employee health and safety even though the devices used and the results obtained are similar to those for pollution abatement. The BEA approach is to limit PAE to expenditures for devices used to reduce or eliminate emissions from the property or activities of the business so as to affect those who are not employees or customers.

The Questionnaire

BEA's annual Plant and Equipment Expenditures Survey was expanded to include questions on capital equipment expenditures for air and water pollution abatement. The questionnaire . . . was mailed to BEA's regular panel in November 1973 and most were returned by respondents in December and January.

While a number of surveys on PAE have been made by government agencies, private research organizations, and trade associations,[3] this was BEA's first such survey and the first all-industry survey by a Federal Government agency. In preparation, BEA representatives interviewed most of the organizations that had conducted these surveys. In addition, discussions were held with representatives of companies in key industries to determine what kinds of data could be supplied.

A major point made clear by this investigation is that there are two classes of PAE. Expenditures for "end-of-line" treatment of pollution are measured more easily because they are made solely for that purpose. Expenditures for prevention or reduction through "changes-in-production-process" are more difficult because they have a joint purpose and involve joint costs.

End-of-line (EOL) treatment involves the separation, treatment, or reuse of pollutants after they are generated but before they are emitted from the firm's property. EOL pollution abatement generally uses standardized techniques, such as trickling filters, dust collectors, filters, precipitators, or other separately identifiable units.

Changes-in-production-process (CIPP) involves the modification of existing processes or the substitution of new production processes to reduce or eliminate the pollutants generated or emitted. CIPP pollution abatement may involve the substitution of raw materials, the use of improved catalysts, the reuse of waste, or the alteration of equipment.

This division into EOL and CIPP is important for two reasons. First, CIPP expenditures—being difficult to measure—are sometimes neglected when total PAE is estimated. Second, CIPP will increase as new plants and processes are designed to meet environmental standards.

Since PAE differ from other capital expenditures in several ways, these differences affected the questionnaire design. Perhaps the most important difference is that these expenditures are not made in the hope of profit, but rather in response to present or anticipated government requirements or to ethical or public relations considerations. Although some pollution abatement techniques do recover valuable materials, these by products rarely cover more than a fraction of the operating cost of the equipment. Such capital expenditures are nonproductive in the sense of the company's profit or loss even though they are productive in the sense of the public's desire for pollution reduction. As a result, problems of definition and availability must be solved if the data collected are to be useful.

Definition

Business is uncertain about which expenditures should be included in PAE. Some of these uncertainties reflect the conceptual problems discussed pre-

viously; some of them are the result of specific operational problems. The questionnaire attempts to solve problems of definition in two ways. First, the lead question of the series (question 3) restricts the respondent's consideration to "expenditures for new plant and equipment to control air or water pollutant emission from his *property or activities*." This was intended to eliminate expenditures for manufacturing pollution abatement equipment or materials for sale to others and, in addition, to eliminate expenditures for plant and equipment intended to improve the health, comfort or safety of employees or customers on the firm's property. Question 3 also asks respondents to indicate if they had no pollution abatement plant and equipment expenditures—a response to this question that is equally important to accurate estimating.

Second, item 7 of the instructions explicitly defines PAE for plant and equipment. This definition reiterates the concept of pollutants emitted from the company's property or generated by its activities, and it provides a list of air and water pollutants that was derived from the regulations and publications of the Environmental Protection Agency.

Availability

Since separate records of PAE are not normally required for operating businesses, accountants and managers do not usually keep separate records of such expenditures. Although certain types of capital PAE are eligible for special tax treatment, many companies choose not to use the more rapid depreciation rate allowed and hence keep no special records.

This problem was discussed with many company representatives, and the consensus was that capital PAE could be obtained by examining individual records or, if this were too time consuming, most companies could construct reasonably accurate estimates. Therefore, instruction 10 states that if records are not available, respondents should provide carefully prepared estimates.

BEA approaches the problems of availability by asking three questions about PAE. Question 4 asks for expenditures for new plant and equipment when the only purpose is air or water pollution abatement. Question 5 asks for expenditures for normal production or business equipment that has special features to prevent or reduce pollutant discharges. Question 6 then asks for the respondent's best estimate of the cost of that part of those expenditures (reported in 5) attributable to special features for air or water pollution abatement.

The distinction between expenditures reported in 5 and 6 and those reported in 4 was based on the estimating procedure that the typical respondent was expected to follow rather than on the technical difference between CIPP and EOL plant and equipment. The typical respondent was expected to be able to report most EOL expenditures directly from his records. Because CIPP expenditures are not easily estimated, the respondent was asked first to record the total spent for equipment with a joint pollution abatement and production purpose and then to estimate how much of this expenditure was attributable to pollution abatement features.

Critique of the Questionnaire

As mentioned earlier, the questions on PAE were added to BEA's annual Plant and Equipment Expenditures Survey. Respondents were asked to complete the section on PAE as a part of a regular survey, in addition to the usual questions on new plant and equipment spending. The response to this survey was not markedly different from previous Plant and Equipment Expenditures Surveys although some respondents may have taken more time to return the forms than in the past.

The response rate for questions on expenditures for CIPP (5 and 6) was

only slightly less than that for question 4 on expenditures solely for air or water pollution abatement. This slightly lower rate may be due to the less frequent use of CIPP methods of abatement than EOL, but it is also clear that some companies found these questions confusing. The data supplied were checked by telephone whenever misunderstanding was indicated and the respondent's intent could not be ascertained from other data. Questions 5 and 6 will be modified and improved when the survey is repeated.

Major Spending Patterns

Business spending for pollution abatement new plant and equipment in 1973 and planned expenditure for 1974 as indicated by BEA's survey are shown in table 1. The estimating methods used in this and other tables shown are based on the procedures of BEA's regular annual Plant and Equipment Expenditures Survey. (See *Survey of Current Business,* January 1970, pp. 25–40.)

These estimates are for 1973 and 1974 capital expenditures only and reflect neither equipment installed in previous years nor the current costs of labor, materials, or services for abatement. Comparisons of pollution abatement expenditures by industries should not be based on one year's capital PAE alone. For comprehensive comparison, operating PAE should be measured. Also, the volume and kind of pollutants vary among industries. Finally, for some pollutants, standard techniques and equipment are available, whereas in other cases only experimental equipment exists. For example, smoke abatement programs were initiated by a number of local jurisdictions in the 1940's, and equipment for the removal of particulate emissions is readily available. In contrast, the removal of sulfur oxides from flue gas has proved to be particularly troublesome; thus, equipment for this purpose is still in intensive research and development. For these reasons the patterns of PAE by industry summarized below are not intended as a comprehensive evaluation of industry abatement activity.

Business spent a total of $4,938 million for capital PAE in 1973. As expected, manufacturing accounted for the largest share, $3,153 million, or 63.9 percent of the total.

Capital PAE in manufacturing was almost equally divided between durable and nondurable goods; durables spent $1,579 million, or $5 million more than nondurables.

Primary metals dominated durable goods manufacturing, spending slightly more than 50 percent, or $814 million. Transportation equipment spent $170 million, with the motor vehicles spending $143 million of that amount. Stone, clay, and glass spent $144 million. In nondurable goods, food including beverage ($152 million), paper ($355 million), chemical ($416 million), and petroleum ($555 million) accounted for nearly 94 percent of the total.

Approximately $1,785 million was spent for capital PAE by all of nonmanufacturing; this was 36 percent of the all-industry total. Electric utilities dominated nonmanufacturing, spending $1,409 million, or 28.5 percent of the total. "Commercial, communication, and other" spent $201 million; wholesale and retail trade accounted for a large percentage of this amount.

Most spending was for air pollution abatement, accounting for 64.3 percent of the total, in durable goods manufacturing, each industry except electrical machinery spent more on air than on water pollution abatement. Food including beverage, textiles, paper, and chemical spent more on water than on air pollution abatement in nondurable goods. In nonmanufacturing, mining, railroad, and gas utilities spent more for water than for air.

If business plans materialize, capital PAE will increase substantially in 1974 (table 1).[4] Total planned capital PAE is expected to increase 32.5 percent, with air PAE increasing 36.9 percent and water PAE 24.6 percent. Durable goods manufacturing plans to increase air capital PAE 26.2 percent, water capital PAE 45.2 percent, and total capital PAE 30.7 percent. The correspond-

ing figures for nondurable goods are 66.8 percent, 33.7 percent, and 51.4 percent. For nonmanufacturing they are 25.9 percent, 3.0 percent, and 17.5 percent.

These expenditure estimates are based on plans in November and December of 1973, when the survey was taken. Plans for all new plant and equipment expenditures in 1974 have been re-estimated based on later survey data (*Survey of Current Business,* June 1974).

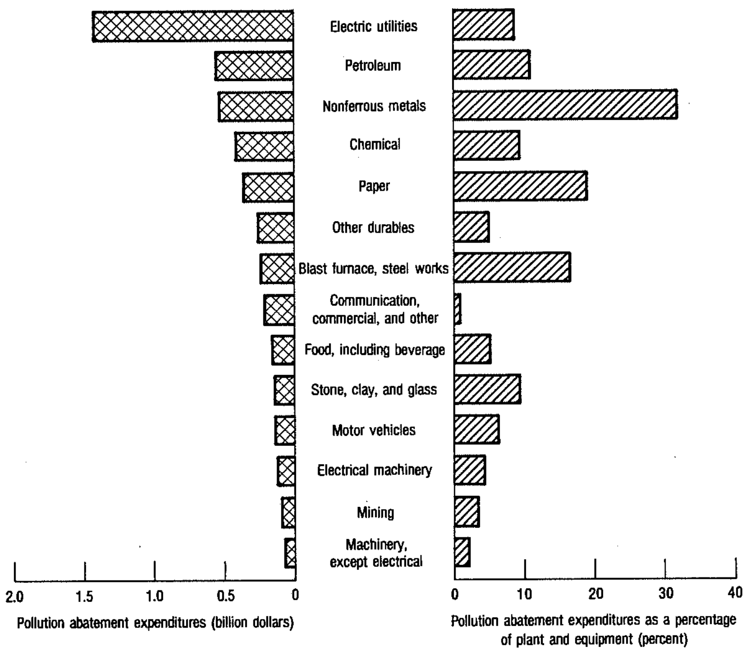
Four industries planned to increase their capital PAE more than 50 percent: stone, clay, and glass (95.8 percent), petroleum (66.8 percent), blast furnace, steel works (65.7 percent), and food including beverage (51.3 percent). Aircraft equipment manufacturing and air transportation are the only industries that plan to decrease capital PAE—35.0 and 40.0 percent, respectively.

Figure 1 shows industries that spent more than $50 million for total capital PAE in 1973, ranked by magnitude of spending. The lefthand bar graph shows total capital PAE by industry; the righthand bar graph shows the percentage that each industry's total capital PAE is of its total capital expenditures for all purposes. Thus, chart 4 contrasts the ranking of industries by their contribution to abatement in absolute terms with the efforts of those industries as indicated by the percentage of their total new plant and equipment expenditures that are devoted to abatement.

Electric utilities spent $1,409 million for air and water pollution abatement—more than any other industry. Five industries spent $3,258 million, or

Figure 1

Pollution Abatement Expenditures for New Plant and Equipment, by Selected Industries, 1973



U.S. Department of Commerce, Bureau of Economic Analysis.

Table 1

Capital Expenditures by U.S. Business for the Abatement of Air and Water Pollution,[1] Estimated 1973 and Planned 1974

	Expenditures for new plant and equipment (millions of dollars)							
	1973				1974			
	Total [2]	Pollution abatement			Total [2]	Pollution abatement		
		Total	Air	Water		Total	Air	Water
All industries	**100,076**	**4,938**	**3,176**	**1,762**	**112,114**	**6,543**	**4,346**	**2,196**
Manufacturing	**38,003**	**3,153**	**2,050**	**1,103**	**44,404**	**4,446**	**2,292**	**1,517**
Durable goods [3]	19,389	1,579	1,207	372	22,611	2,063	1,523	540
Primary metals [3]	3,481	814	712	101	4,337	1,003	841	163
Blast furnace, steel works	1,407	230	163	67	1,712	381	304	78
Nonferrous	1,679	523	492	31	2,156	553	469	83
Electrical machinery	2,895	129	44	85	3,179	175	53	122
Machinery, except electrical	3,478	80	52	28	3,975	118	74	44
Transportation equipment	3,063	170	96	74	3,570	195	112	83
Motor vehicles	2,244	143	81	62	2,682	178	103	75
Aircraft	531	20	11	10	580	13	7	6
Stone, clay, and glass	1,503	144	123	22	1,683	282	244	39
Other durables [3]	4,969	243	180	63	5,867	290	200	90

Nondurable goods [3]	18,614	1,574	843	731	21,793	2,383	1,406	977
Food including beverage	3,048	152	68	84	3,276	230	112	118
Textile	787	29	9	20	773	43	17	26
Paper	1,893	355	174	181	2,484	500	326	174
Chemical	4,324	416	203	213	5,249	608	293	316
Petroleum	5,409	555	352	203	6,888	926	610	316
Rubber	1,567	48	26	23	1,580	51	33	18
Other nondurables [3]	1,586	19	12	7	1,543	24	16	9
Nonmanufacturing	**62,073**	**1,785**	**1,126**	**659**	**67,710**	**2,097**	**1,418**	**679**
Mining	2,759	91	41	50	3,143	100	53	47
Railroad	1,939	16	5	11	2,272	19	3	16
Air transportation	2,413	15	12	4	2,160	9	4	5
Other transportation	1,605	11	6	5	1,617	17	10	7
Public utilities	19,087	1,451	921	530	22,163	1,696	1,179	518
Electric	16,250	1,409	906	503	18,808	1,651	1,160	491
Gas and other	2,837	42	15	27	3,355	46	19	27
Communication, commercial, and other [4]	34,270	201	142	58	36,355	256	170	87

[p] Preliminary.
[1] Data exclude expenditures of agricultural business and outlays charged to current account.
[2] Estimates are based on expected capital expenditures reported by business in late November and December 1973. The estimates for 1974 have been adjusted when necessary for systematic biases in expectational data.
[3] Includes industries not shown separately.
[4] Includes trade, service, construction, finance, and insurance.

Note.—Details may not add to totals because of rounding.
Source: U.S. Department of Commerce, Bureau of Economic Analysis.

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66 percent of the total: electric utilities ($1,409 million), petroleum ($555 million), nonferrous metals ($523 million), chemical ($416 million), and paper ($355 million).

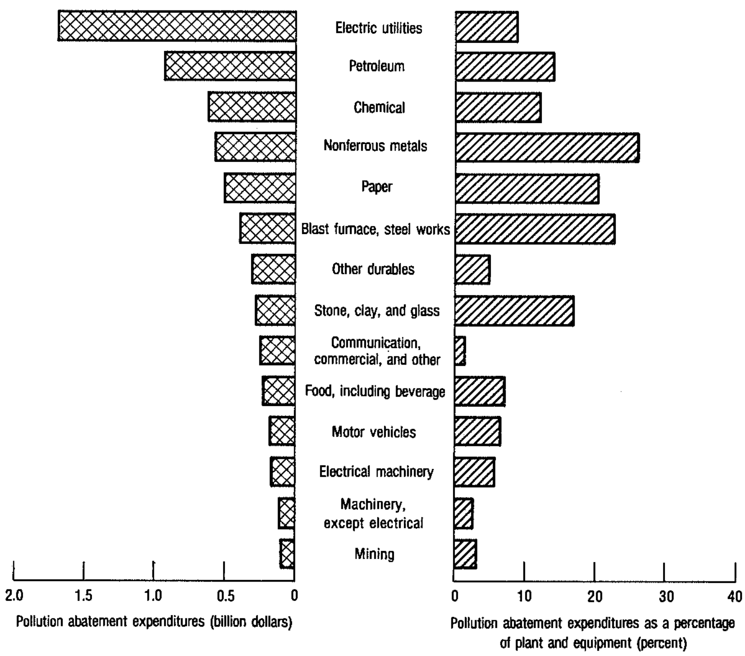
The ranking changes significantly when capital PAE is considered as a percentage of each industry's total capital expenditures. Nonferrous metals spent 31.1 percent of its total 1973 new plant and equipment budget for air and water pollution abatement—the largest percentage of any industry. Four industries spent more than 10 percent: nonferrous metals (31.1 percent), paper (18.8 percent), blast furnace, steel works (16.3 percent), and petroleum (10.3 percent).

Figure 2 provides the same comparison in planned capital PAE spending for 1974. The five industries that spent most in 1973 remain the top five for 1974: electric utilities ($1,654 million), petroleum ($926 million), chemical ($608 million), nonferrous metals ($553 million), and paper ($500 million), Industries planning to spend more than 10 percent of their total capital budgets for pollution abatement are: nonferrous metals (25.6 percent), blast furnace, steel works (22.3 percent), paper (20.1 percent), stone, clay, and glass (16.8 percent), petroleum (13.4 percent), and chemical (11.6 percent).

As stated above, one year's capital PAE do not provide a good basis for comparison among industries. It is interesting nonetheless to estimate a crude rate of participation as the percentage that total capital expenditures of com-

Figure 2

Anticipated Pollution Abatement Expenditures for New Plant and Equipment, by Selected Industries, 1974



U.S. Department of Commerce, Bureau of Economic Analysis.

panies with PAE is of total capital expenditures for the industry. In other words, this rate of participation is a measure of the portion of the industry with capital PAE as weighted by total new plant and equipment expenditures.

In this basis, the rate of participation for all industries was 56.0 percent. Manufacturing had a rate of participation of 77.4 percent, with durables at 74.8 percent and nondurables at 80.0 percent. As expected, nonmanufacturing had a lower rate, 42.9 percent. Industries with rates of participation higher than 90.0 percent were: electric utilities (99.5 percent), petroleum (99.5 percent), blast furnace, steel works (96.0 percent), nonferrous metals (94.3 percent), and stone, clay, and glass (92.4 percent).

Table 2 shows the CIPP portion of each industry's estimated capital PAE in 1973, and planned capital PAE for 1974. The distinction between EOL and CIPP is not precise. Nevertheless, these figures do provide a rough measure of

Table 2

Capital Expenditures for the Abatement of Air and Water Pollution Through Changes-In-Production-Process,[1] Estimated 1973 and Planned 1974

	Estimated in 1973 (millions of dollars)			Planned in 1974 (millions of dollars)		
	Total	Air	Water	Total	Air	Water
All industries	**1,169**	**724**	**444**	**1,465**	**1,003**	**462**
Manufacturing	**712**	**446**	**266**	**1,042**	**721**	**321**
Durable goods [2]	321	220	101	499	397	102
Primary metals [2]	112	82	29	250	239	11
Blast furnace, steel works	75	56	19	114	109	4
Nonferrous	29	19	9	118	111	6
Electrical machinery	35	14	21	46	16	30
Machinery, except electrical	36	24	12	42	27	15
Transportation equipment	37	20	17	29	17	12
Motor vehicles	35	19	16	28	17	12
Aircraft	0	0	0	0	0	0
Stone, clay, and glass	50	42	8	58	48	10
Other durables [2]	52	37	15	73	50	23
Nondurable goods [2]	391	226	165	543	324	220
Food including beverage	49	25	24	67	35	32
Textile	11	3	8	7	3	4
Paper	14	7	7	31	16	15
Chemical	149	88	61	188	109	79
Petroleum	151	94	57	239	153	86
Rubber	12	6	6	8	6	2
Other nondurables [2]	5	4	1	5	2	2
Nonmanufacturing	**457**	**278**	**179**	**423**	**283**	**140**
Mining	20	15	5	28	22	6
Railroad	5	3	2	3	2	2
Air transportation	2	2	0	1	0	0
Other transportation	4	3	1	5	3	2
Public utilities	386	226	160	307	200	107
Electric	372	223	149	295	197	98
Gas and other	14	3	11	11	2	9
Communication, commercial, and other [3]	41	31	10	80	57	23

[1] The complement of changes-in-production-process expenditures (end-of-line expenditures) can be derived by using this table and table 1.
[2] Includes industries not shown separately.
[3] Includes trade, service, construction, finance, and insurance.

Note.—Details may not add to totals because of rounding.
Source: U.S. Department of Commerce, Bureau of Economic Analysis.

the portion of abatement investment that involves process change. For business as a whole, CIPP expenditures were 23.7 percent of total PAE in 1973 and 22.4 percent in 1974. For manufacturing, the corresponding figures are 22.6 percent and 23.4 percent. A comparison of 1973 and planned 1974 expenditures for CIPP may not be a good indicator of the trend because the former are based on actual installations and firm plans, whereas the latter may represent amounts budgeted, but not yet allocated to specific equipment or engineering designs.

Question 7 asks for that part of capital PAE that is to meet current or expected local, State, or Federal pollution abatement regulations. Few companies keep separate records of projects initiated to meet these regulations and of those initiated for other purposes: therefore, most answers to question 7 were estimates. Approximately 91.2 percent of the all-industry total capital PAE in 1973 was spent to meet local, State, or Federal pollution abatement regulations. For manufacturing, 92.0 percent was spent for this purpose, with durable and nondurable goods spending 92.5 percent and 91.6 percent. Little variation was found among industries. Machinery except electrical was the only industry with less than 80 percent of its expenditures to meet government regulations.

Question 8 asks, "If restrictions on pollution discharges have caused your company to reduce expenditures for new plant and equipment in 1973—or planned expenditures in 1974—from what they would otherwise have been, please estimate the amount of such reduction." Approximately 90 percent of the respondents indicated no reduction or did not answer the question. An additional 8 percent indicated "NA" (not available or not applicable). While it is possible that in some industries pollution abatement restrictions have caused a reduction in investment, the low positive response to this question indicates that business as a whole does not think of pollution abatement regulations as reducing investment in new plant and equipment.

References

1. Excludes agricultural business, real estate operators, medical, legal, educational, and cultural services and nonprofit organizations.
2. A preliminary discussion paper, "A Conceptual Basis for the Collection of Pollution Abatement Expenditures and Costs," is available on request from the Bureau of Economic Analysis, U.S. Department of Commerce.
3. The Federal Power Commission, McGraw-Hill, Conference Board, Manufacturing Chemists Association, and American Petroleum Institute have conducted such surveys.
4. The estimated planned expenditures reported in table 1 have been adjusted for systematic biases by using expectational data developed in BEA's regular annual Plant and Equipment Expenditures Survey.

CHAPTER 3

Environmental Conditions and Trends

One of the Council's principal tasks is to provide information about the condition of the environment and important trends in environmental quality. Such information is essential if the Nation is to make informed decisions about protecting the environment and managing natural resources. This information must be available and comprehensible not only to environmental scientists but also to the general public, elected officials, and other decisionmakers.

This year's chapter presents information about population growth, air and water quality, projecting pollutant generation, minerals and materials resources, pesticides, wildlife and habitat, and the development of techniques for interpreting environmental information. In addition, a section containing basic environmental statistical data is provided for the first time.

Population

World Population Trends

Growth in world population is one of the fundamental factors shaping the quality of life on earth. Increasing populations place increasing demands upon the earth for sustenance, intensify exploitation of resources, and strain the ability of the environment to absorb and support man's needs. Just as important, increasing population makes it extremely hard for poor nations to improve the life of their peoples. On the other hand nations which achieve modest population growth can enhance living conditions in their countries and prevent degradation of the environment.

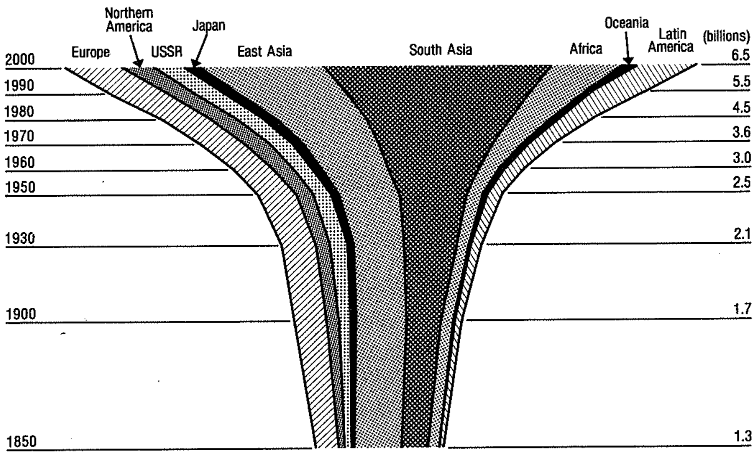
The United Nations designated 1974 as World Population Year to focus international attention on the seriousness of the world population problem. The UN Population Conference, held in August 1974 in Bucharest, is discussed in Chapter 5. In this section, we wish to set forth the basic determinants and consequences of world population growth.

Accelerating Growth—The rate of population growth is determined by the birth rate and the death rate. For centuries the world's population grew very slowly, because high birth rates were offset by high death rates. In comparatively recent times, death rates, especially infant mortality rates, have been drastically reduced throughout the world. In contrast, birth rates have not changed to any large degree except in economically developed nations.[1] The result has been an accelerated growth of the world's population.

In 1830, the world's population was 1 billion. In 1930, just 100 years later, the population reached 2 billion. In 1960, 30 years later, the 3 billion level was attained. The world's population will be 4 billion in 1975—only 15 years after the third billion was reached. Even assuming some moderation in future growth rates, the world's population may reach 6.5 billion by the year 2000, with the last billion having been added in only 9 years. After the year 2000, each increase of 1 billion will come in even shorter periods of time. Figure 1 shows

Figure 1

Estimated Growth and Regional Distribution of the World's Population, 1850-2000[1]



[1] Assumes continuation of 1963 fertility levels.

Source: UN Secretariat, Population Division, and J.A. Durand, "The Modern Expansion of World Population," *Proceedings of the American Philosophical Society,* Vol. III, No. 3, June 1967, cited in UN Fund for Population Activities, *WPY Bulletin,* No. 1, May 1973.

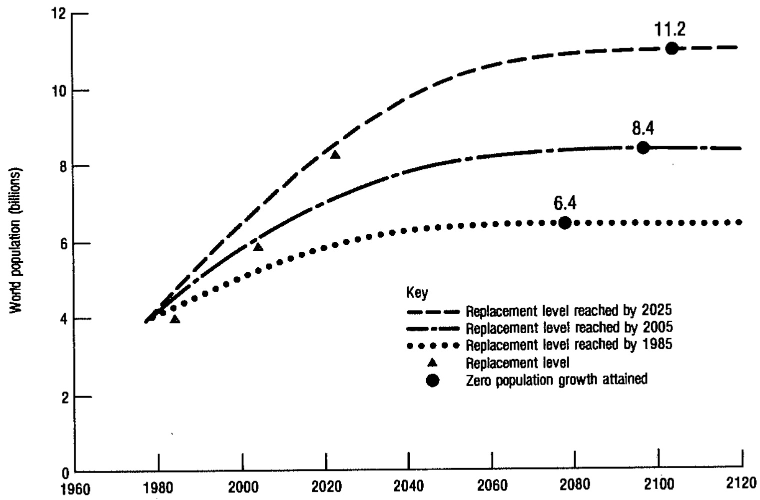
this exploding growth of the world's population. Unless slowed and ultimately stabilized, such growth seems likely to preclude the possibility of improving or even maintaining the present quality of life.

Built-In Momentum—The "population explosion" contains a built-in momentum, for as long as growth rates are above the replacement level (2.1 children per couple), a population will continue to grow. Even after the replacement level is reached, a population will continue to increase significantly for another 50 to 100 years.

This momentum is built in because high birth rates in recent years have resulted in a disproportionate number of young people who are potential parents. Hence even if these potential parents have only enough children to replace themselves, their offspring will further increase the size of the total population. Figure 2 illustrates the effects of this built-in momentum. Assuming policies to reduce fertility are not extraordinarily successful and hence do not bring fertility down to the replacement level until 2025, world population will not stabilize until the end of the next century, by which time there will probably be at least 10 to 12 billion people.[2] This growth rate is illustrated by the upper curve. If population policies are more successful, so that the replacement level is reached by the year 2005, zero population growth will still not occur until the year 2095, when the population will be 8.4 billion. This growth rate is shown by the middle curve.

Figure 2

Momentum of Population Growth



Explanation- The table shows world population growth assuming replacement levels are achieved by and maintained after the dates indicated.

Source: U.S. Department of State, *The Population Explosion: A Present Danger* (1974).

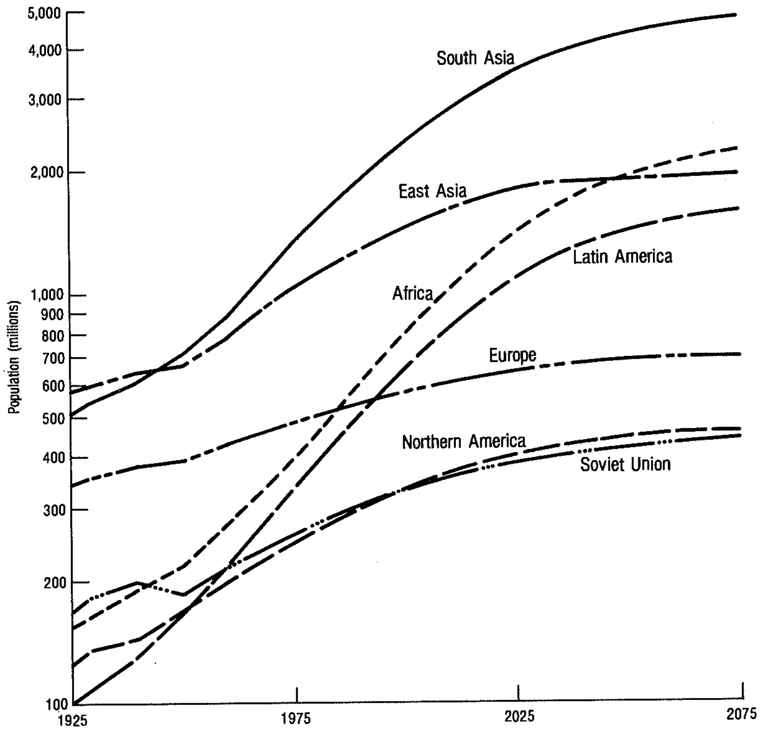
If population policies are very successful, so that the replacement level is achieved by 1985, population will stabilize at about 6.4 billion people in the year 2075, as shown by the lower curve.

Thus far only a few nations have achieved zero population growth—East Germany, West Germany, and Luxembourg, whose combined populations total about 78 million people.[3] Other nations are approaching the replacement level but are still experiencing slow population growth; Sweden, United Kingdom, Finland, Austria, Belgium, and Hungary are experiencing annual population growth rates of 0.3 percent. But most nations in the world (and those with the largest populations) are currently growing at a rate far above the replacement level.

Regional Comparisons—Long-range regional projections of population growth are shown in Figure 3. On this logarithmic projection,

Figure 3

Population of Major Regions of the World, 1925-2075[1]



[1] According to the UN medium variant of long-range projections (charted on a logarithmic scale)

Source: UN Population Commission, *Preliminary Version of Concise Report on the World Population Situation*, E/CN.9/IIISS/CRP.1 (14 February 1974), Figure 2, p. 50.

a steeper slope indicates a faster growth rate. The figure shows that some regions which have had relatively small populations will soon surpass other regions with larger populations. For example, during the 1980's Africa and Latin America will attain larger populations than Europe.

Contrasts Between Developed and Developing Countries

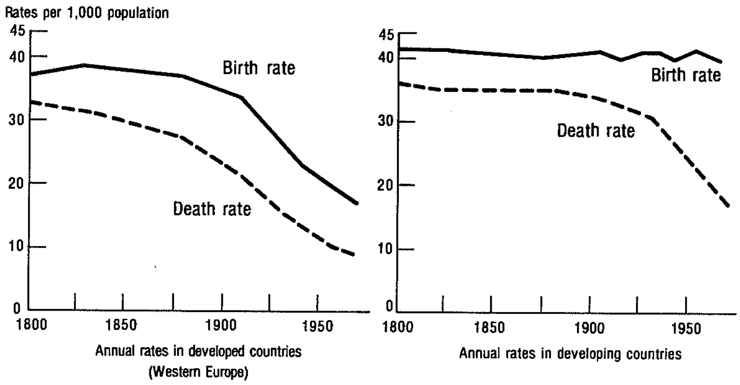
Thus far discussion has presented the global view. But there are great differences between the developed and developing countries. An understanding of these differences helps to illuminate the basic factors in population growth.

Birth and Death Rates—Figure 4 shows why the population explosion has occurred. The chart on the left shows birth and death rates representative of developed countries in Western Europe. At the start of the 19th century, birth rates were about 37 per 1,000 population and death rates were about 32 per 1,000. The overall population growth rate was thus about 0.5 percent annually.

During the next 170 years, however, as a result of improved medical practice, public sanitation, personal hygiene, and nutrition on the one hand and social and economic changes stemming from the industrial revolution on the other, death rates declined to less than 10 per 1,000. This decline in the death rate resulted in 10 to 20 percent more surviving children, a high percentage of whom also

Figure 4

Annual Birth and Death Rates in Developed and Developing Countries, 1800-1968



Source: U.S. Department of State, based on UN data.

had children.[4] Hence the decline in the death rate had an accelerating effect on population growth.

After a time lag of 30 to 70 years, the decline in the death rate was paralleled by a similar decline in birth rates. Reasons for the decline in birth rates are complex. As a result of the industrial revolution, families moved from rural areas to cities, fewer children were needed for farm labor, increasing numbers of women took jobs, more young people deferred marriage in order to pursue education, and more parents decided to have fewer children. At the same time, increasing per capita income, an expansion of literacy, and the development of more effective methods of contraception played a role. The result over time was a decline in the birth rate to a level of 15 to 18 per 1,000 population.

The present population growth rate in the developed countries (births minus deaths) is similar to that experienced in 1800, before death rates began to decline. In short, a new equilibrium—with lower birth rates approximating lower death rates—has been achieved. (Population growth in the United States, which is similar though influenced greatly by immigration, will be considered in more detail later.)

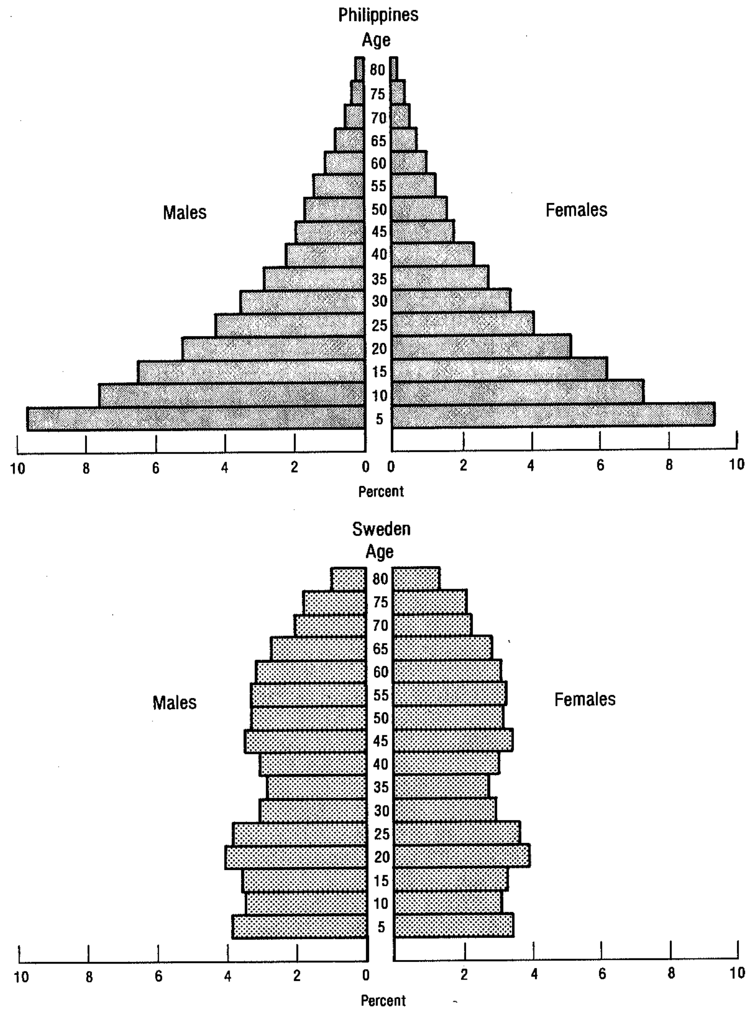
The right hand part of Figure 4 shows the contrasting situation for the developing countries, which now account for 70 percent of the world's population. In the developing countries, birth rates in the 19th century were about 40 per 1,000 population and death rates were about 35 per 1,000 population; hence the rate of population growth was also about 0.5 percent. But beginning in Latin America in the 1920's and continuing throughout the world from the 1940's to the present, the application of fully developed modern medical practice (particularly a massive United Nations effort to wipe out malaria), together with the introduction of public sanitation, reduced death rates to half their former level—from 35 per 1,000 population to a level of 18 per 1,000 population. At the same time birth rates remained essentially unchanged. Consequently, population growth rates in developing countries rose rapidly to a level of 2.5 to 3.5 percent annually and, in a few areas, to even higher levels. A population growing at a 3 percent annual rate doubles in 23 years. That such growth has occurred without massive famine is a tribute to improvements achieved in agriculture.

To achieve the demographic transition that took place in the industrialized nations requires the developing countries to face a major task—to lower birth rates so as to match the lowered death rates. The experience of the developed nations suggests that the process of economic development is important in achieving this transition.

Social and Economic Differences—Developed and developing countries differ markedly in the distribution of population at various age levels, the degree of education, and the per capita income. Figure 5 shows the proportion of population by age group in two coun-

Figure 5

Age Distribution of the Population of the Philippines and Sweden, 1965



Source: UN Department of Economic and Social Affairs, *The Determinants and Consequences of Population Trends,* Population Studies No. 50 (1970), Vol. I, p. 267.

tries—the Philippines, representative of the developing countries, and Sweden, representative of the developed countries. The age profile in developing countries is generally shaped like a pyramid; in developed countries, the shape is more rectangular. In the developing countries a little over 40 percent of the population is below 15 years of age.[5] Some adults are elderly or otherwise unemployed; hence on the average there is less than one economically productive adult for each dependent child. In developed countries, by contrast, only about 27 percent of the population is under age 15. Hence, developed countries have about double the ratio of economically productive adults per child.

An efficient labor force requires good education. Therefore education is one of the principal requirements for economic growth and modernization. But when the school-age population is large and growing rapidly, as it is in most developing countries, the provision of facilities and qualified teachers and staff is extremely difficult, particularly because productive adults are also needed for other investment efforts required to support economic growth.[6] In some developing countries, only about half of the primary age children enter school and of these more than half drop out before reaching fourth grade. Yet the population growth is so rapid that some of these countries have increased their expenditures for education between 13 and 18 percent a year, while government revenues have increased only 4 to 5 percent a year.[7] In developed countries, in contrast, essentially all children aged 5 to 14 attend school, and a substantial number finish secondary school and go on to complete college or its equivalent.

The contrast in economic status between the developed and developing nations is equally stark, as is shown in Figure 6. The GNP of the developed nations was 5 times larger than that of the less developed nations in 1970. On a per capita basis, the difference was about 13-fold and far greater than that for countries on the extreme ends of the scale. In light of the rapid population growth in the developing countries, this gap in per capita income may widen.

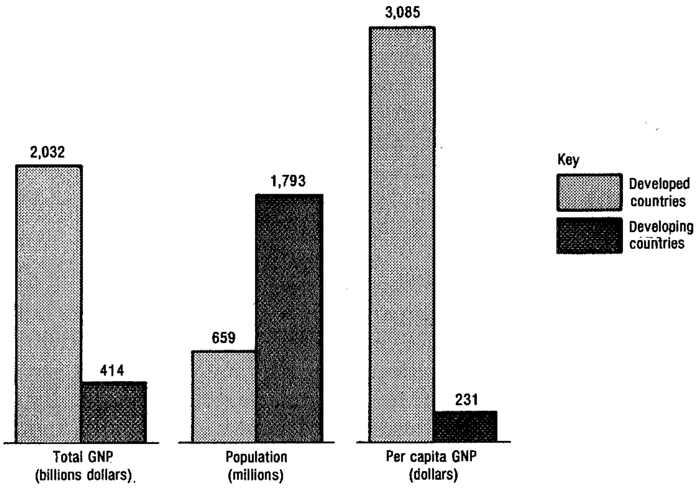
Urban vs. Rural Growth—In the developing countries, most of the population is rural, and some nations are experiencing rural overpopulation.[8] Even though a heavy migration to urban areas is taking place—cities in developing countries are growing by 4.4 percent per year,[9] while population overall is growing at 2.4 percent annually—the greater part of the population will still live in rural areas in the year 2000.

In most developed nations the major shift of population from rural to urban areas is nearly complete. Population in rural areas has more or less stabilized. Growth of urban areas is now largely caused by natural increase (births minus deaths).

By the year 2000, about 51 percent of the world's population (81 percent in developed countries, 43 percent in developing countries) is expected to live in urban regions. In the course of the next genera-

Figure 6

Economic Status and Population in Developed and Developing Countries, 1970[1]



[1] Non-Communist countries: 1970 market prices in U.S. dollars.

Source: U.S. Department of State.

tion, the increase in the cities will amount to nearly 2 billion people, 1.5 billion in developing and almost 0.5 billion in developed countries. Furthermore, this growth in urban population is concentrating in large cities. Table 1 shows that the number of cities with 1 million or more inhabitants is expected to increase from 75 to 273 between 1950 and 1985. Furthermore, between 1970 and 1985 the number of cities with 10 million or more inhabitants will increase from 4 to 17, of which 10 will be in developing countries.

Table 1

Cities with a Population of Over 1 Million

	1950	1970	1985
Number of cities			
World	**75**	**162**	**273**
Developed countries	51	83	126
Developing countries	24	·79	147
Combined population (millions)			
World	**174**	**416**	**805**
Developed countries	126	223	340
Developing countries	48	193	465

Source: UN World Population Conference, *Recent Population Trends and Future Prospects*, Report E/CONF. 60/3, 30 August 1974, p. 68

Urbanization in the developing countries is of particular environmental concern. These nations generally lack adequate infrastructure investment to provide for treatment of drinking water and disposal of waste. Housing is inadequate, and available transportation facilities are overtaxed. Investments to meet these needs must compete with other demands for the limited supply of available capital.

Environmental problems also arise in rural areas of developing countries. Efforts to increase food production often result in cultivation of marginal lands, destruction of forests, dispersal of inadequate supplies of irrigation water, and overgrazing of pasture lands. Erosion and soil depletion result, leading over time to a net decrease in food production. Rural areas often lack safe water supply, sanitary waste disposal, essential health facilities, and adequate housing.

Potential Food Supplies—Through the ages, production of food has been sufficient only to support most of the world population at a subsistence level. During the last several decades, productivity of agriculture has increased tremendously. Because concurrent growth in population has been nearly as great, this increase in output did not relieve the hunger problem faced by most people in the world. In fact, because of crop failures in some areas, the world's reserves of grains have been reduced to an alarmingly low level—less than a 1-month supply.[10] Though increasing demands for food stem mostly from further increases in population, during the 1970's rising affluence in various parts of the world added significantly to the demand for grain in order to feed livestock. This competition for feed grains to enrich diets with animal protein products contributed to rising prices and declining reserves. High food prices are now placing a special burden on the world's poor, as well as undermining the prosperity of the well-fed.

Modern agriculture as practiced in developed countries can produce over 5,000 pounds of plant food per acre per year, sufficient to feed 10 to 12 people on a cereal diet. Production in developing countries is generally about 1,000 pounds per acre per year.[11] The variation is due chiefly to different levels of agricultural technology. Modernization of agriculture in the developing countries is critical, for traditional agriculture cannot continue to meet increasing demands for food.

One line of attack to increase food production is to expand the acreage under cultivation. About 3.5 billion acres in the world are now farmed. Given the limitations imposed by climate, soil conditions, and available water supplies, about 2.5 billion more acres could be cultivated on the basis of present agricultural technology. But in Asia and Europe, where the largest populations reside, virtually no additional arable land is available and, as the population grows, arable land per person decreases. As an example, cultivated land per person in Asia is expected to decrease from ¾ acre in 1965 to ½ acre by 1985.

In Europe, the corresponding figures are 1 acre and ¾ acre. In the United States, about 2½ acres per person are now farmed.

The uncultivated lands are located where populations are less concentrated. In the USSR, farming areas could be increased by half; in North America farmed areas could be nearly doubled; in Africa tripled; in South America more than quadrupled; and in Australia and New Zealand sextupled. Taken together, sufficient additional arable land is available in these less populated regions to permit farming at a rate of 1 acre per person to a time well beyond 1985, even with expected world population increases.

But the development of new farm land in developing countries is blocked less by physical barriers than by social and economic obstacles. Modernization of agriculture requires the development, application, and dispersal of knowledge, as well as industrial skills and the modernization of governmental and other organizations. Capital is also required. The investment required to put the 2.5 billion acres of potentially arable land into production has been estimated at $500 billion to $1 trillion—about twice the present GNP of all the developing countries. And these estimates were made before the recent escalation in the costs of energy.

Modernization of agriculture requires abundant use of energy, especially for irrigation, fertilization, and operation of machinery. For example, in a developed country 2.9 million calories of fossil fuel energy is required to produce a ton of grain containing 3.5 million food calories. To farm in this manner in most developing nations would require about one-third more than the total energy they now consume. By contrast, developed countries use only about 7 percent of their energy in agriculture.

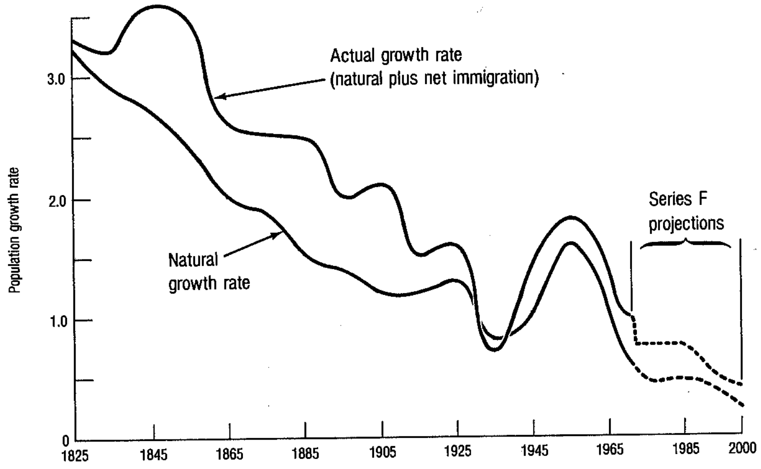
Providing food for the expanding population of developing countries will tax the world's resources and capabilities to the utmost. In most developing countries it will be at least as difficult to secure necessary capital and energy to modernize existing agriculture as to expand conventional farming into potentially arable but as yet unused land. Barring breakthroughs that boost food production without either heavy capital investment or significant social change, massive starvation and mortality, especially in Asia and Africa, are a tangible possibility.

U.S. Population

History—Population growth in the United States has generally paralleled that of other developed countries. Between 1800 and 1972, U.S. population increased from 5 to 210 million. Nevertheless the rate of U.S. population growth declined rather steadily over this period except for a temporary strong increase after World War II. (See Figure 7.) The major cause of this decline was a steady, long-term decrease in the birth rate. In 1820, the U.S. birth rate was 55 per 1000 population; in 1860, it was 44; in 1900, it had dropped to 32;

Figure 7

U.S. Population Growth, Actual 1825-1970 and Estimated 2000



Source: *1974 National Growth Report.*

and in 1936, it hit a low of 18. During World War II, the rate rose slightly to the 20–22 level, then jumped up, reaching 27 in 1946. It was believed at that time that the trend was due to returning war veterans who had necessarily delayed parenthood and that it would soon turn down again.[12]

Instead the birth rate stayed at that higher level for more than a decade. Couples married younger and reproduced at a higher rate than their parents, as the general fertility rate—the number of births per 1,000 females aged 15 to 44—shows. This rate was 110 in the early 1920's, declined to a low of 75 in the late 1930's, then rose steadily to a peak of 120 in the late 1950's.

Growth in population, including immigration, has fallen sharply since 1957. In that year, the population growth rate was 1.7 percent. During 1973, it reached 0.72 percent,[13] a historic low well below any previous year except the previous low point in the mid-1930's. If the annual population growth rate for the United States remains at its present level, it will take about 97 years for the population to double itself; by the year 2000, the U.S. population would be approximately 250 million.

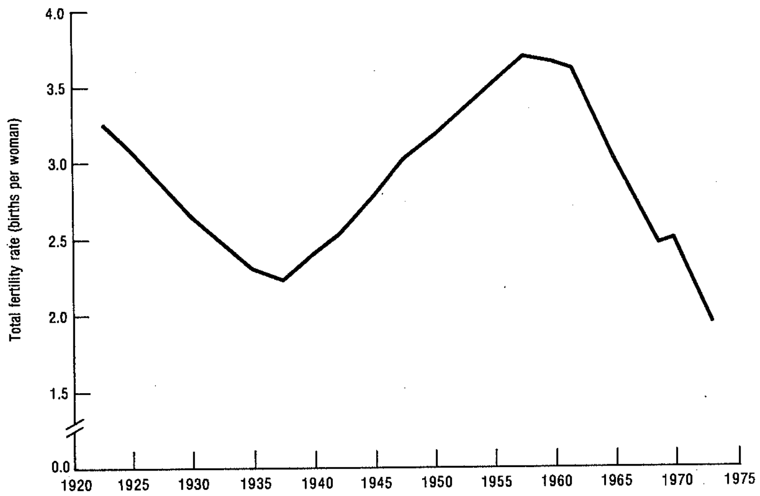
The continued decrease in U.S. population growth rate during 1973 is largely attributable to a further decline in births. The number of births recorded in 1973 was 3.14 million,[14] the least for any year

since 1945. Births were about 3 percent fewer in 1973 than in 1972. Population experts are surprised by this drop. They are not sure why the decline has continued as it has, particularly because the children of the post-World War II baby boom are now in their child-producing years. The total fertility rate, which may be thought of as the average number of births per woman implied by the fertility rate of a given year, continued to decrease, dropping from 2.03 in 1972 to 1.90 in 1973 (Figure 8). This is below the total fertility rate of 2.1 necessary for the U.S. population to reproduce itself exactly, assuming no immigration. But zero population growth has not been achieved in the United States because the population contains a disproportionate number of young persons: 37 percent of the female population is now at the child-bearing age (18–44), and 26 percent is under 15 years of age. Assuming the total fertility rate remains at its present level, the population of the United States will continue to increase for about 70 years before it reaches zero growth.

Projections—In 1972, the Census Bureau revised its projections of U.S. population growth. At that time it dropped its previous highest projections (Series A and B) as no longer likely, given the decline in birth rates. A new low projection (Series F) was developed on the basis of an average of 1.8 births per woman, as contrasted with 2.8

Figure 8

U.S. Total Fertility Rate, 1920-73[1]



[1] 5-year data for 1920-59, single-year data for 1960-73.

Source: U.S. Bureau of the Census, *Special Studies, Fertility Indicators: 1970,* Series P-23, No. 36, April 6, 1971, p.9; 1971, 1972, and 1973 figures are unpublished Bureau of Census data.

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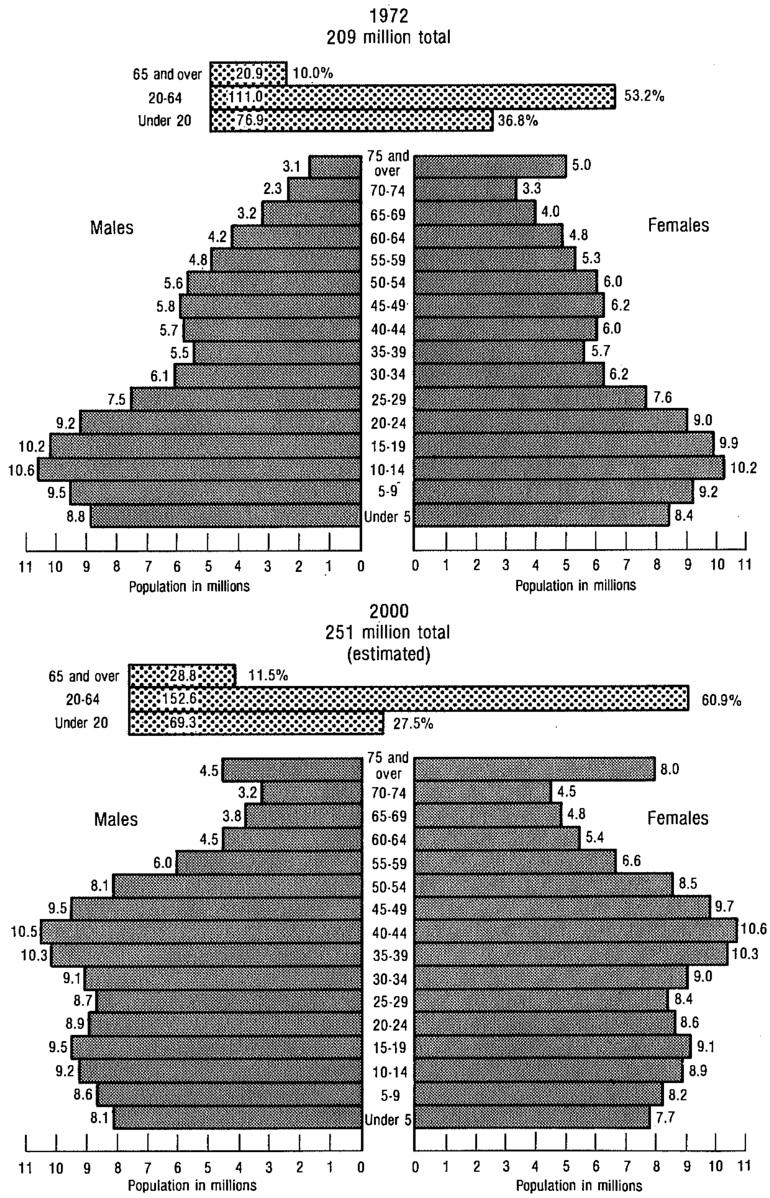
Figure 9

Age Distribution of United States Population, 1972 and 2000



births, which is the basis of Series C, the highest current series. Under the Series F projection, U.S. population would be approximately 250 million in the year 2000 and 265 million in 2020.[15] Any increase beyond that would be due entirely to immigration. Since the total fertility rate of 1.8 assumed in Projection F is only slightly lower than the actual 1973 rate of 1.9, this projection merits increased attention.

It is interesting to examine the characteristics of the U.S. population in the year 2000 if population were to grow in accordance with the Series F Projection. (See Figure 9.) Total population in 2000 would be 20 percent larger than in 1972. The median age would be 35.8 instead of 28.1. And there would be shifts in the national age profile which could be expected to have significant social and economic effects.

As a result of the lower birth rate, the number under 20 years of age would decrease from about 77 to 69 million by the year 2000, or from 36.8 percent to 27.5 percent of total population. New schools would not be needed, except for replacement and to take care of population shifts. Also, fewer teachers would be required, unless the ratio between pupils and teachers were changed.

The group aged 65 and over would increase from about 21 to 29 million, but as a percentage of total population the shift would be very small—from 10.0 percent to 11.5 percent. Thus, although there would be a need for more housing and health care facilities for the elderly, the increase would represent practically no change relative to the number of economically productive adults.

If the young and the old are taken together as those dependent on the working age population for their support, the total in the year 2000 (98.1 million) turns out to be virtually the same as in 1972 (97.8 million). As a percentage of the total population, however, these two age groups taken together would decline from 47 percent of the population in 1972 to only 39 percent in the year 2000.

The most significant change will be the great increase in those between the ages of 20 and 64 (153 million in 2000 compared to 111 million in 1972). Since these are the ages during which people enter the work force and produce goods and services, this growth would provide the Nation with a large increase in potential productive capacity. It would also challenge the economic system to provide jobs for all.

Reducing Population Growth Rate

Reduction of population growth requires that couples realize the desirability of having small rather than large families. Motivation toward this goal usually accompanies economic and social development or is the result of a strong desire to achieve development. Realization of the goal depends on widespread understanding of the basic facts of the reproduction process and the availability of means to

control births. Public education and widespread information about fertility control are essential, along with readily accessible and inexpensive family planning services. Worldwide there are currently about 133 million live births and over 55 million abortions per year.[16] Wider use of contraceptive techniques not only helps to moderate population growth but also reduces the practice of abortion and infanticide.

Progress Toward Modernization of Population Growth—Fortunately, many nations are now vitally concerned about population growth. Twenty-four of the less developed nations, including the People's Republic of China, India, and Indonesia, have adopted national goals to reduce their population growth rates. As of 1970, these countries together had nearly 1.9 billion people—about 53 percent of the world's population. At their present average annual rate of growth of 2.41 percent, these nations by 1985 would have 2.7 billion people, an increase of 42 percent in 15 years. Their goals call for a reduction of the average annual rate of growth to 1.62 percent by 1985. If achieved, the combined population of these countries would then be 2.5 billion in 1985, an increase of 32 percent over this period.[17]

Several nations have shown that birth rates can be substantially reduced, giving credibility to the goals that are being established. It is worth reviewing the progress that some countries have made.

Among the developed nations, Japan has reduced population growth remarkably.[18] The birth rate was reduced from 34.3 per 1,000 population in 1947 to 17.2 a decade later. Over the last 5 years, the birth rate has leveled out at 19 per 1,000. The average population growth rate is 1.2 percent per year; at that rate population would double in about 58 years. To a large degree, Japan's accomplishment was made possible by an extensive national program of aiding and informing a highly motivated and literate populace in family planning. The change in Japan's population growth rate also coincided with a significant increase in gross national product.

Another example is the Republic of Korea, which adopted a national population policy in 1962 and implemented it with extensive information campaigns and family planning services provided through health stations located in virtually every population center and through mobile vans and cooperating physicians in rural areas.[19] By 1971, more than 1.4 million of an estimated population of 4 million fertile women were participants in family planning programs. Consequently, the annual population growth rate dropped from 3.0 percent in the early 1960's to 1.9 percent in 1971. (The doubling time at 1.9 percent is 36 years.) Once again, much of Korea's success can be correlated with the national goal of increasing economic growth, which seems to instill a motivation to have smaller families.

Another example is that of Taiwan where the annual population growth rate was reduced from 3.0 percent in 1963 to 1.9 percent in

1972, at which time 45 percent of wives aged 20–44 were using family planning services.[20] The goal of the current program is to reduce the rate further by enrolling more participants. In Taiwan all government agencies help to implement the national population policy. Private and public institutions participate, and numerous health stations and public hospitals are involved. Field workers and private doctors assist under government contracts. Mass communications media are used extensively to promote family planning through radio spots, television, slides at movie theaters, posters in buses and trains, advertisements on matchboxes, and releases to newspapers. In addition, new mothers are offered free family planning assistance. Military recruits are also given orientation in fertility control.

Reports from the People's Republic of China are also very promising. On the basis of partial reports, population growth is believed to have dropped remarkably in recent years. It is estimated that the annual growth rate in this nation of 800 million is now about 1.7 percent (doubling time—41 years). China achieved this success by encouraging couples to marry at a more advanced age, by thorough indoctrination in family planning techniques at the time of marriage, by dispensing contraceptives free to married couples (sales being forbidden),[21] and by working out schedules listing the exact years in which certain employed women plan to have children.[22]

Despite the fact that India is undertaking its fourth national 5-year plan to extend family planning, the annual population growth rate is still at the relatively high figure of about 2.5 percent (doubling time—28 years).[23] Currently, only about 15 percent of the 100 million couples estimated to be in the reproductive age group is reached by family planning advice or services. With over 600 million people, the need to control population growth more effectively is urgent for India.

Several of the smaller developing nations also provide encouraging demonstrations that birth rates can be substantially reduced. These nations have a high degree of literacy and strong programs to reach the people with family planning services. The results achieved thus far are shown in Table 2.

Need for Better Fertility Control—As nations set goals for lower population growth and as couples decide to have fewer children, the personal needs of couples for efficient, economical means for achieving smaller families with dignity comes sharply into focus. In the developed countries, family planning has been an effective factor in reducing births. But present methods of contraception are too expensive and not generally available for use by the masses in the developing nations. A recent survey of 209 countries found that although 94 percent of the world's population live in countries which have some family planning services, only a minor fraction of those who need such services actually have access to them.[24]

Moreover, existing family planning techniques may not be sufficiently effective. For example, a study in the United States reported

Table 2

Change in Population Growth Rates in Selected Small Countries with National Population Control Programs

Country	Percent literacy	Percent annual population growth rate		Decrease in births per 1,000 population
		Pre-program [1]	Post-program [2]	
Singapore	76	2.90	1.74	11.6
Hong Kong	71	2.78	1.40	13.8
Trinidad and Tobago	89	2.97	1.75	12.2
Mauritius	61	2.92	1.77	11.5
Costa Rica	84	3.80	2.70	11.0

[1] Average for mid-year 1960 to mid-year 1965, except for Costa Rica, for which 1960 figure is used.
[2] Figures for Trinidad and Tobago are for the year 1970; others are for 1971.

Source: UN Fund for Population Activities, *WPY Bulletin* No. 5, September 1973.

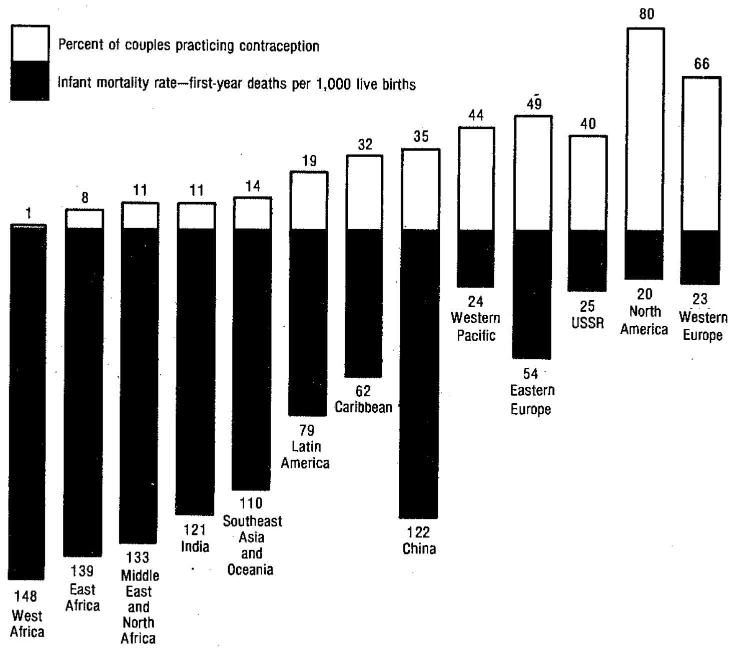
that 15 percent of the births in the period 1965 to 1970 were unwanted by the parents at time of conception. An additional 29 percent of the births occurred to couples who wanted an additional child but not at the time of conception.[25] Hence, this study indicates that roughly half of the pregnancies that occurred during this period were not desired, despite widespread availability of family planning services.

A concentrated effort is needed to develop simpler, more effective, and economically practical techniques for worldwide use. But worldwide expenditures for research on fertility control are well below $100 million per year [26]—only 10 percent of what the U.S. Government spends on cancer research alone. Various estimates indicate that the pharmaceutical industry spends nearly $20 million annually on new fertility control methods. Government and private laboratories spent somewhat more than $60 million on research and training in reproductive biology during 1973. At present there is no concentration of effort on any particular aspect of fertility control. About 60 percent of the research consists of small grants funded by U.S. agencies, the National Institutes of Health, and the Agency for International Development. The balance of research funds is provided by U.S. foundations and universities and by other governments, of which Sweden is the principal donor nation.

Contraceptive practice in selected countries has been correlated with infant mortality, as shown by the bars in Figure 10. Generally, infant mortality decreases as contraceptive practice becomes more widespread. It may be inferred that the mother who practices family planning is able to maintain better health by spacing her children farther apart without recourse to abortions, thereby making possible better nutrition for herself and the family. Generally, babies and mothers are healthier and happier when births are wanted and properly spaced. There is a high correlation between the good health and nutrition of mothers, the successful completion of pregnancies,

Figure 10

Contraceptive Practice and Infant Mortality Rates in Major Areas of the World



Source: *People,* 1:6 (October 1973)

and lower infant mortality of children that are born live. Similar correlations can be made between these factors and family income and cultural influences.

The "population explosion" is perhaps the most important factor affecting the future of the world. A breakthrough in economical, effective, voluntary birth control would do more to assure future world populations of a satisfactory quality of life than virtually any other accomplishment that man can achieve.

Air Quality

During the past year, the Environmental Protection Agency (EPA) completed a major evaluation of data on nationwide trends in air quality and emissions over the period 1940–72. EPA reported that some improvements in the Nation's urban air quality have been achieved in recent years. Occurrences of poor air quality are still

commonly observed, however, and worsening trends have been noted in some areas.

Also during the past year, the Nation's energy shortages, aggravated by the Arab oil embargo, brought about significant shifts in the types and quantities of fuels used by motor vehicles and stationary sources of emissions. Since nearly 90 percent of man's air pollutant emissions from stationary and mobile sources are generated by the combustion of fuels,[27] these shifts in fuel use had immediate impacts on air quality. Although the impacts have not yet been fully analyzed, preliminary data available on case examples suggest that the altered patterns of energy consumption produced both positive and negative effects on air quality.

Nationwide Air Quality Trends

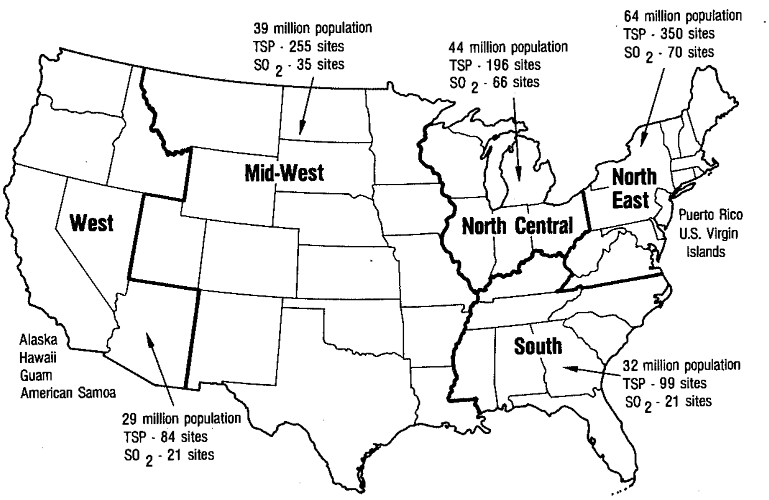
In recent years, the Nation's capability to analyze trends in air quality has been considerably strengthened by the continuing development of a coordinated system of monitoring networks and data banks. Largely in response to requirements of the 1970 Clean Air Act Amendments, this capability has improved as a result of Federal, state, and local efforts. Information provided by these systems is still incomplete but is nearing planned levels. For example, air quality monitoring data submitted by the states to EPA's National Aerometric Data Bank (NADB) currently exceed 80 percent of those planned by EPA for 1974 achievement in the nationwide monitoring program. At present, more than 3 million data values are being analyzed quarterly. Some monitoring categories are nearer planned levels than others. Figure 11 shows the distribution of NADB monitoring sites meeting EPA's trend criteria for ambient air quality measurements, as described in Table 3. The most significant improvements expected to occur in the near future include better measurement of photochemical oxidants and monitoring of relatively pristine areas.

During the past year, EPA completed the first annual *Air Quality and Emissions Trends* report of the National Air Monitoring Program.[28] This report analyzed nationwide ambient trends in the major air pollutant categories for various recent years, the latest being 1971. The report also presented nationwide emissions trends for the past 3 decades. In a subsequent *Monitoring and Air Quality Trends Report,* EPA analyzed 1972 data.[29] These two reports are based on Federal, state, and local data from the NADB, the National Emissions Data System (NEDS), the National Air Sampling Network (NASN), the Continuous Air Monitoring Program (CAMP), and other programs, as described in Table 4. These programs are conducted to provide air quality information to the public and to assist Federal and state officials in assessing progress toward the achievement of the National Ambient Air Quality Standards.

On the basis of these data, EPA reported that although total na-

Figure 11

Georgraphical Distribution of Air Monitoring Sites Meeting EPA's Trend Criteria, 1973



Source: U.S. Environmental Protection Agency.

tionwide emissions have increased in the major air pollutant categories in recent years, reductions have been observed in ambient air concentrations of sulfur dioxide (SO_2) and total suspended particulates (TSP) at many urban monitoring sites. These reductions were apparent in many areas where air quality formerly had been worst. But some degradation has been observed in other areas that formerly had exhibited few or no signs of air pollution.

Any interpretation of ambient air quality trends should be tempered by an understanding of the limitations in present data collection pat-

Table 3

EPA's Criteria for Data Selection [1]

Pollutant	Criteria
Total suspended particulates	Valid Year [2]
Sulfur dioxide	Valid Year [2, 3]

[1] To be included in this analysis, a site had to meet these criteria in either 1970 or 1971 and in either 1972 or 1973.
[2] For TSP and SO_2 noncontinuous sampling instruments 24-hour measurements) or greater), a valid year of data is defined as a year of data with 4 valid quarters, where a valid quarter must have a minimum of 5 samples. If no samples are collected in 1 month, neither of the other 2 months in that quarter may have less than 2 samples reported.
[3] For SO_2 continuous sampling instruments (less than 24-hour measurement), a valid year must have 75 percent of the total number of possible observations.

Table 4

EPA's Major Air Quality and Emissions Monitoring Networks and Data Banks

National Aerometric Data Bank (NADB)
Compiles and analyzes air quality data collected primarily by state and local agencies (but also from Federal monitoring programs) at monitoring sites located in 247 Air Quality Control Regions across the country. Data are submitted by the states to EPA on a quarterly basis. Considerable time (several months) is presently required for transmittal, authentication, assimilation, and analysis of state data. Until recent years, submission of state data was on a voluntary basis, so the historic record is severely limited by incompleteness, inadequacies, and inconsistencies in the available data.

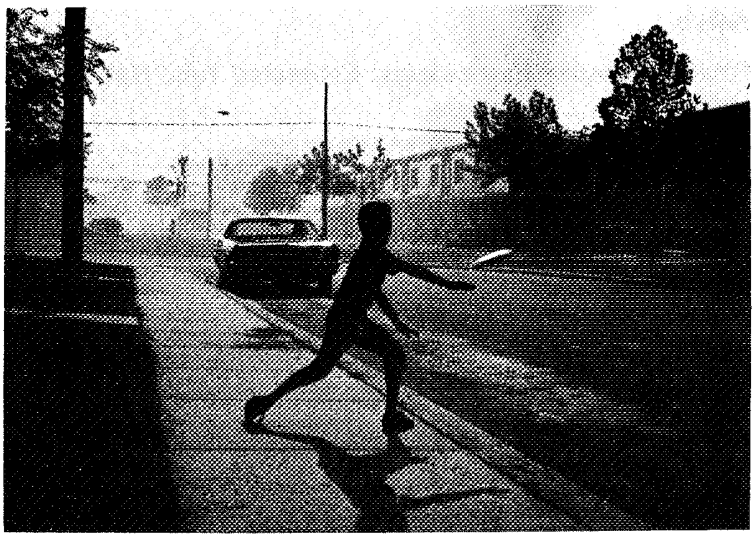
National Emissions Data System (NEDS)
Compiles and analyzes emissions data for each Air Quality Control Region and emissions source category, submitted semiannually by the states. Approximately 900 source categories, 3,300 area sources, and 65,000 point sources are described nationwide. Emissions estimates for each region are calculated on the basis of emissions factors and control efficiencies for each source.

National Air Surveillance Network (NASN)
The principal Federal air quality monitoring network, begun in the mid-1950's and presently including more than 200 monitoring sites operated with state and local cooperation. Limited for the most part to one monitoring site (usually center-city) per major urban area, so frequently unable to characterize air quality influences of outlying industrial sources. Best available long-term historic nationwide record for TSP and SO_2, although decentralization efforts since 1973 have produced some apparent disruption and delays.

Continuous Air Monitoring Program (CAMP)
Federal system for continuous monitoring of gaseous air pollutants, initiated by U.S. Public Health Service in 1962 to provide a historic trends record and to investigate effects of short-term fluctuations in source strengths, winds, temperature, and precipitation on measured ambient pollutant concentrations. Operated by EPA, cooperatively with city agencies, in Chicago, Cincinnati, Denver, Philadelphia, St. Louis, and Washington, D.C. Generally limited to one center-city site per urban area. Presently being decentralized.

Other Programs
Conducted for special purposes. These include EPA's Particle-Size Network, Membrane Filter Network, Precipitation Network, and Community Health and Environmental Surveillance System (CHESS), as well as many state and local monitoring programs and special studies, addressed to regional and local air quality assessment needs.

terns. Many of the data discussed below were obtained from only one or two monitoring sites in each city, sites often located in central business districts. Because industry and automobile traffic may be increasing more rapidly in outlying sections of the city than in downtown areas, the measurements presented may not be accurately representative of the entire urban area. Furthermore, the examination of ambient air quality data does not by itself reveal the influence of meteorological factors such as inversions, temperature, or rainfall. Year-to-year and month-to-month fluctuations in ambient air quality are influenced by these factors as well as by emissions and control measures.



In the following pages, trends for each of the major pollutants—particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides—will be described. Both emissions data and ambient data are included.

Particulate Matter—Particulates in air vary greatly in size and chemical composition, as well as in ambient concentration. Even before industrialization, there was a substantial and variable level of airborne particles produced by wind erosion, forest fires, volcanoes, and other natural phenomena. These emissions, classified by EPA as "uncontrollable," are, of course, still being produced. Man adds to this natural background level by burning fossil fuels, by creating conditions which increase wind erosion, and by producing dusts, sprays, and various chemical emissions. Most particles do not remain airborne longer than a few days, being returned to earth by gravity, rain, and other natural phenomena.

"Controllable" nationwide emissions of Total Suspended Particulates (TSP) have reportedly increased approximately 15 percent over the past three decades (Table 5), although some of this increase may be attributable to refinements in the inventory procedures. The estimated fluctuations in natural, or "uncontrollable," emissions, such as forest and agricultural fires, have been of greater magnitude than reported increases. In several major categories, controllable TSP emissions have decreased (or slowed their increase) over this period (Table 6). Techniques to control particulate emissions have included shifts in fuel use from coal to oil or gas, wider use of technologies such as filtering, scrubbing, and electrostatic precipitation to reduce stack emissions, and restrictions on open burning of solid waste.

Table 5

Total Suspended Particulates: Estimated Total Nationwide Emissions

[In millions of tons per year]

	1940	1950	1960	1970
Controllable	19.2	20.8	21.0	22.3
Total [1]	44.9	33.2	29.9	25.5

[1] Includes sources which are considered "uncontrollable" by EPA's definition. These include such categories as forest, structural, and agricultural fires. Because the year-to-year variability in "uncontrollable" sources can be great, the apparent downward trend in estimated *total* emissions should be viewed with caution. Estimated total TSP emissions for 1969, for example, were 35 million tons.

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. 1, pp. 1–6ff.

During the 1960's, average ambient TSP levels in urban areas reportedly declined on the order of 25 percent. This trend is illustrated by Federal NASN data on average annual and maximum daily concentrations (Figure 12). The composite TSP average for urban NASN stations decreased from approximately 110 micrograms per cubic meter in 1960 to 82 in 1972. At NADB stations, annual average TSP concentrations also exhibited nationwide declines (Figure 13), although most levels were still above the secondary standard in 1973. Some of the apparent improvement can be attributed to the siting of powerplants and other industrial point sources in outlying areas, away from the center-city locations of most NASN monitoring sites. Individual cities have exhibited mixed trends in the past few years, as indicated by the ratio of annual average levels to EPA's primary ambient standard, as shown in Table 7.

Although EPA's primary and secondary standards for ambient

Table 6

Total Suspended Particulates: Rates of Change in Estimated Weight of Total Nationwide Emissions for Selected Stationary Source Categories

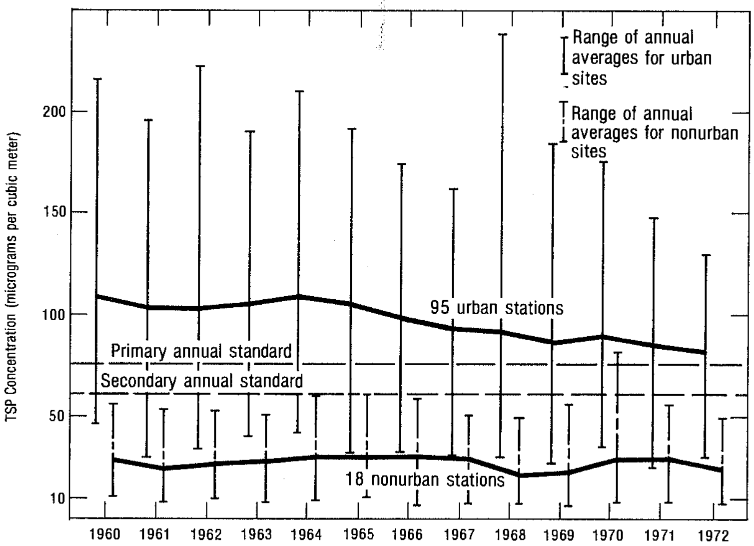
[By percent per year]

	1940–60	1960–70
Industrial process	1.5	1.1
Fuel combustion	−1.1	−1.1
Steam electric utilities	4.1	−1.8

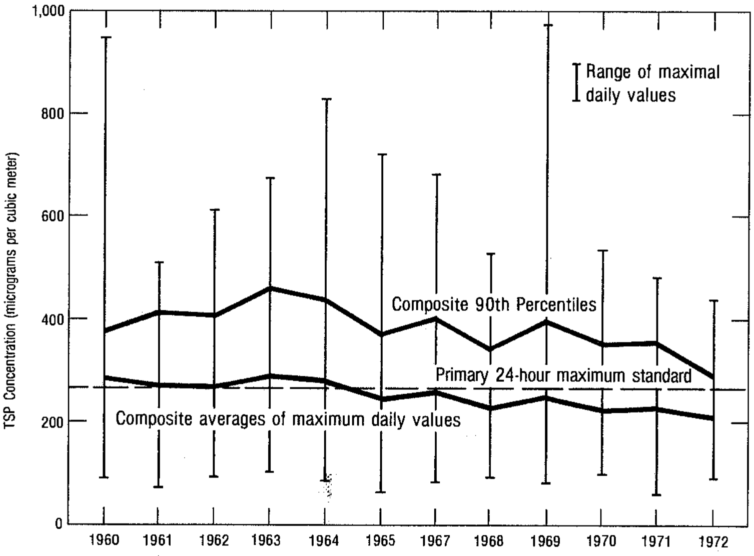
Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. I, pp. 1–6ff.

Figure 12

Trends in Total Suspended Particulate Concentrations, 1960 Through 1972, at National Air Sampling Network (NASN) Stations



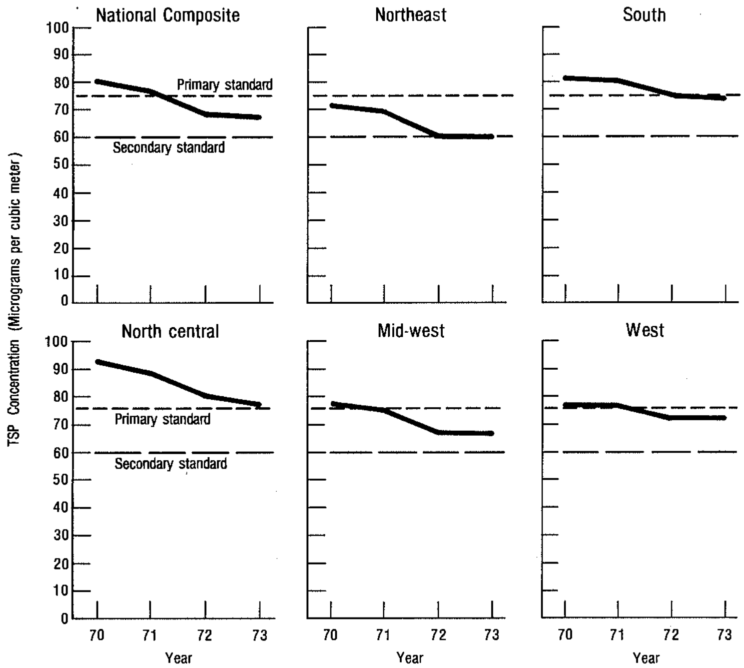
Composite annual averages at urban and nonurban NASN stations



Composite average and 90th percentiles of annual maximum daily concentrations at 95 urban NASN stations

Figure 13

National and Regional Trends in Total Suspended Particulates, National Aerometric Data Bank (NADB) Stations, 1970-73



Source: Environmental Protection Agency.

TSP were exceeded at most NASN stations in 1971, the nationwide percentage of NASN sites at which ambient TSP standards were exceeded declined during the past decade (Table 8). Such improvement has been observed at a number of NASN locations where TSP readings had been highest in the 1960's. In 1972, for example, no violations of air quality standards were reported in 12 of the Air Quality Control Regions that EPA had formerly classified as TSP Priority I (most severe) and Priority II.

Despite this improvement, most NASN stations continue to detect violations of ambient TSP standards (Table 8 and Figure 14). Moreover, some of the stations at which the lowest TSP levels were formerly observed have exhibited some apparent recent degradation. Of the 28 Air Quality Control Regions which had been classified as TSP Priority III (least severe) and for which available 1972 data are sufficient for analysis, 9 regions exceeded the primary annual standard and 12 exceeded the primary 24-hour standard. Thus, although

Table 7

Total Suspended Particulates: Ratio of Annual Mean to EPA Primary Standard[1] in Selected Cities

City	1967	1968	1969	1970	1971	1972	1973
Los Angeles	1.22	1.72	1.24	1.67	1.77	1.57	[2] 1.60
Denver	1.24	1.42	1.51	1.63	1.57	2.03	[2] 2.61
Washington, D.C.	1.13	1.14	0.98	[2] 1.01	0.97	1.11	[2] 1.08
Chicago	N.A.	1.49	1.80	1.49	1.53	1.30	[2] 1.16
Boston	N.A.	1.23	1.14	[2] 1.07	[2] 1.13	1.07	[2] 0.79
St. Louis	1.49	N.A.	2.48	[2] 2.04	1.17	1.24	[2] 1.28
Cincinnati	1.48	1.32	1.30	1.34	1.20	1.16	[2] 1.00
Philadelphia	2.00	1.49	1.69	1.80	1.33	1.03	1.16
Pittsburgh	1.78	2.15	1.92	1.69	[2] 1.48	1.80	N.A.
New York City	2.18	N.A.	1.41	1.64	[2] 1.41	1.27	[2] 1.53

[1] A ratio of 1.00 means that the annual average ambient concentration was exactly at the level of the primary standard (75 micrograms per cubic meter, annual average).

[2] These readings do not meet EPA criteria for statistical validity, in most cases because an insufficient number of samples have been reported for the year.

Source: Based on EPA data from the National Air Sampling Network.

Table 8

NASN Stations Exceeding Primary and Secondary Annual Mean and 24-Hour Maximum Standards for Suspended Particulate Matter, 1960–71

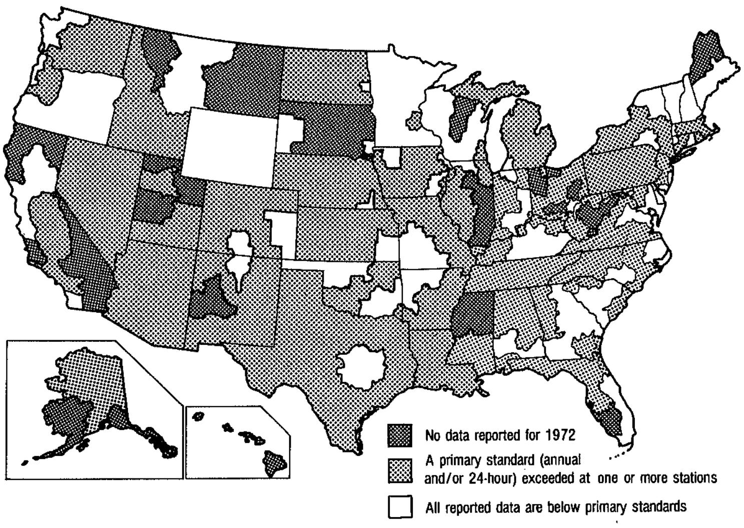
Year	Number of stations	Stations exceeding primary annual mean standard[1]		Stations exceeding secondary annual mean standard[2]		Stations exceeding primary 24-hour maximum standard[3]		Stations exceeding secondary 24-hour maximum standard[4]	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1960	74	63	85	71	96	32	43	68	92
1961	72	55	76	63	88	30	42	63	88
1962	74	61	82	67	91	29	39	65	88
1963	86	66	77	80	93	43	50	76	88
1964	80	67	84	74	93	41	51	72	90
1965	89	72	81	83	93	35	39	72	81
1966	77	58	68	69	90	33	43	70	91
1967	90	61	70	80	89	23	26	66	73
1968	122	76	62	104	85	37	30	99	81
1969	165	97	59	139	84	40	24	112	68
1970	170	115	69	153	90	43	25	128	75
1971	130	78	62	104	80	27	21	88	68

[1] Primary annual mean standard=75 $\mu g/m^3$.
[2] Secondary annual mean standard=60 $\mu g/m^3$.
[3] Primary 24-hour maximum standard=260 $\mu g/m^3$.
[4] Secondary 24-hour maximum standard=150 $\mu g/m^3$.

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. 1, Table 4–5.

Figure 14

Total Suspended Particulate Levels, 1972



Source: EPA, *Monitoring and Air Quality Trends Report, 1972* (1973), Figure 3–1.

it appears that ambient urban TSP levels have somewhat improved nationwide, especially in some of the worst areas, there also are signs of degradation in regions not previously assigned a high priority for TSP enforcement.

Even in cases where monitoring data indicate substantial improvement in ambient TSP, it is important to recognize that at the present time, neither routine TSP monitoring nor ambient standards distinguish between large particles and fine particulate matter (particles that are less than 3 microns in diameter). Fine particulates in air are produced by natural processes, stack emissions, automotive emissions, and secondary atmospheric reactions. On a weight-for-weight basis, these fine particles are much more difficult to control, remain airborne longer, reduce visibility more, penetrate the respiratory system more deeply and efficiently, and pose a greater health hazard than larger particles. Fine particulates in air have been implicated as preferential adsorption or condensation sites for toxic trace elements.[30] In addition, studies by EPA's Community Health and Environmental Surveillance System (CHESS) have suggested that sulfates associated with fine particulates are more highly correlated than TSP or SO_2 alone with adverse effects on human health.[31]

Of the 22.3 million tons of TSP emissions estimated to have been

produced nationwide in 1970 by "controllable" sources, approximately 4 million tons were estimated to consist of particles smaller than 3 microns in diameter. Of these, an estimated 1 million tons were composed of particles smaller than 1 micron.[32] These estimates are tentative, since data from actual measurements of particle size distributions are scarce. However, most present-day stack control devices for particulate removal are more efficient in removing large particles than fine particulates.[33]

Although ambient air quality standards, monitoring, and emissions data on particulates are now based primarily on total weight, the importance of the fine particulate fraction is being increasingly recognized. In future development of improved ambient air quality standards and monitoring capabilities, the size distribution and chemical composition of particulates will need to receive greater consideration.

Sulfur Oxides—Sulfur oxides are potentially corrosive, acrid substances emitted primarily during the combustion of sulfur-containing fuels such as coal and oil. Between 1940 and 1970, estimated nationwide emissions of sulfur dioxide (SO_2) increased from about 22 to 33 million tons per year (Table 9). Much of this increase was due to steam electric power plants, since from 1940 to 1970, annual average increases in power plant SO_2 emissions were nearly five times the national average rate for all sources (Table 10). Since 1970, nationwide increases were stemmed somewhat by regulated changes in the types and sulfur content of fuels used by power plants, factories, and other stationary sources. Installation of stack controls has also contributed to reducing SO_2 emissions.

In spite of increased nationwide emissions, ambient SO_2 levels in urban air have reportedly declined more than 50 percent since the mid-1960's according to composite 1964–72 data on average annual and maximum daily concentrations at 32 urban NASN sites (Figure 15). Overall declines were reported for 31 of these 32 stations. The apparent discrepancy between rising emissions and decreasing ambient measurements probably reflects in part the siting of new power plants and other large industrial facilities in outlying areas away from

Table 9

Sulfur Dioxide: Estimated Total Nationwide Emissions

[In millions of tons per year]

	1940	1950	1960	1970
Controllable	22.2	24.3	22.6	33.3
Total	22.8	24.9	23.2	33.4

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Table 1-5.

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Table 10

Sulfur Oxides: Rates of Change in Estimated Weight of Total Nationwide Emissions for Selected Stationary Source Categories

[By percent per year]

	1940–60	1960–70
Industrial process	1.3	3.0
Fuel combustion	0.2	4.2
Steam electric utilities	6.5	6.7

Source: Environmental Protection Agency, *Monitoring and Air Quality Trends Report, 1972* (1973), pp. 4–1ff.

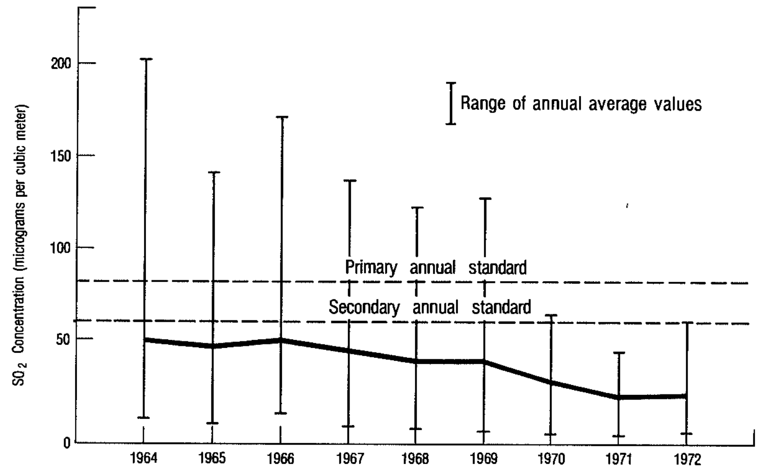
center-city NASN monitoring sites, as well as the increased use of natural gas and fuel oil rather than coal by small urban stationary sources.

However, evidence from other monitoring programs supports the ambient improvements indicated by NASN data. Ambient SO_2 levels also declined at most NADB stations (Figure 16). The percentage of NASN monitoring sites nationwide at which ambient SO_2 standards were exceeded has shown progressive reductions since the mid-1960's (Table 11). For 10 selected cities, such improvements also are evidenced by yearly trends in the ratio of annual average SO_2 levels to EPA's primary standard (Table 12). Nationwide, out of 162 Air Quality Control Regions for which data were sufficient for analysis, 19 reported violation of some primary standard in 1972, and 7 regions exceeded the secondary 3-hour ambient standard (Figure 17). As was noted for particulate matter, many of the monitoring stations which formerly reported the highest SO_2 levels have shown the greatest improvement.

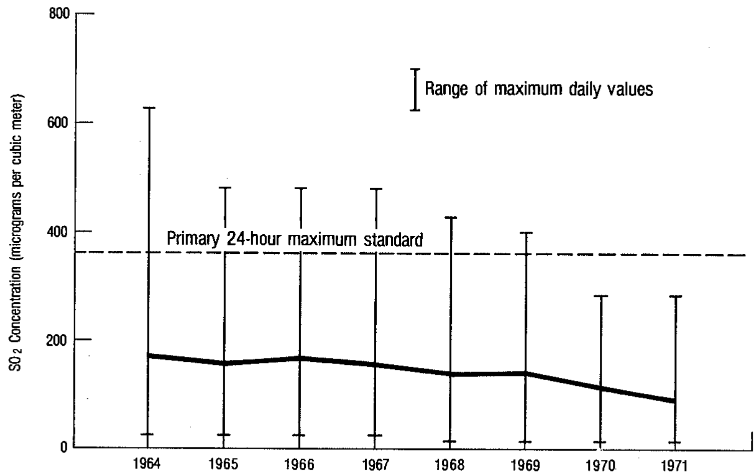
However, the full impacts of recent variances and fuel-use shifts on these improvements have not yet been determined. In addition, present information indicates that it may be necessary to focus more on sulfates than on SO_2 in the monitoring and assessment of ambient air quality. Sulfates (sulfuric acid or metallic salt compounds) are formed from the oxidation of sulfur in fuels and from atmospheric reactions which convert SO_2 or SO_3 to sulfates. Although ambient standards and monitoring have mostly been directed at SO_2, studies by EPA's Community Health and Environmental Surveillance System have suggested that human respiratory diseases are more closely associated with sulfates than with SO_2,[34] and that sulfates may in many cases be an order of magnitude more toxic than SO_2. Although sulfate toxicity needs considerable further investigation, such studies have suggested that adverse effects on human health may be associated with exposure to ambient sulfate concentrations in excess

Figure 15

Trends in Sulfur Dioxide Concentrations, 1964-72, National Air Sampling Network (NASN) Stations



Composite annual averages at 32 NASN stations

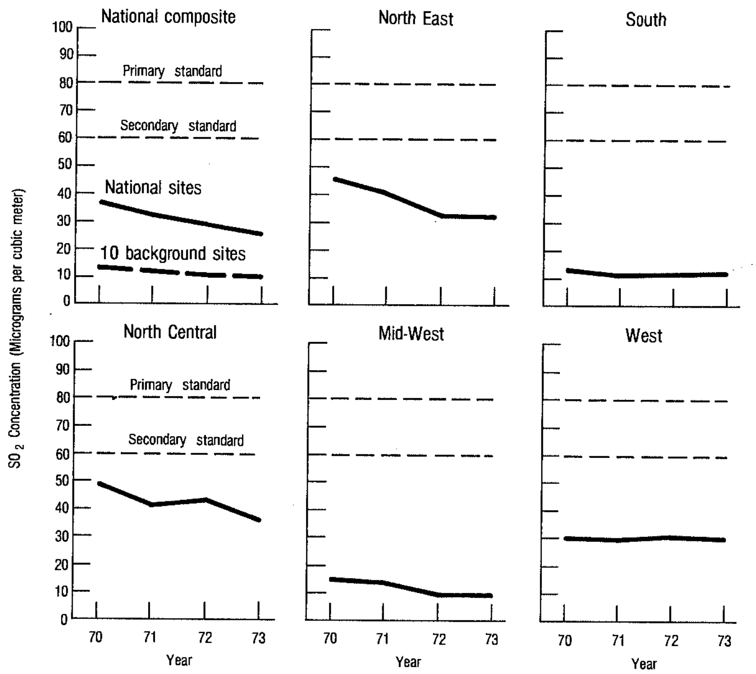


Composite averages of annual maximum daily concentrations at 32 urban NASN stations

Source: EPA, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Figures 4-10 and 4-11.

Figure 16

National and Regional Trends in Sulfur Dioxide, National Aerometric Data Bank (NADB) Stations, 1970-73



Source: Environmental Protection Agency.

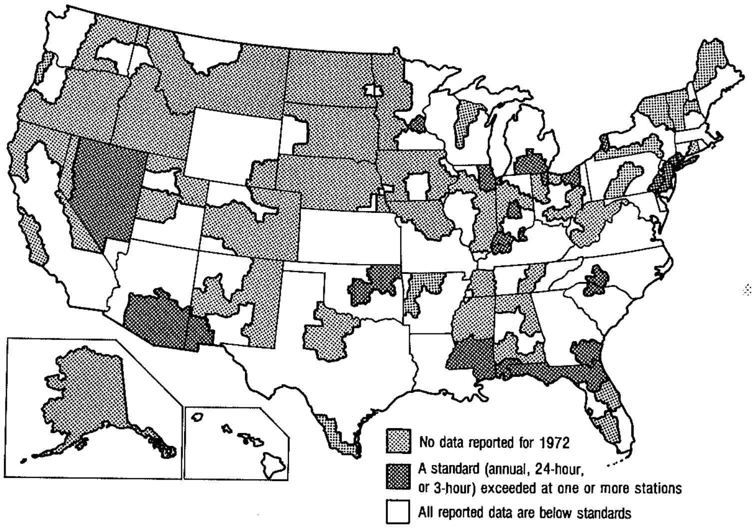
of 8 micrograms per meter for 24 hours.[35] At present, 9 non-urban NASN stations, primarily located in the East, report annual average sulfate concentrations in excess of this level.

Sulfates in air are often associated with fine particulate matter. Although some previous studies had reported that ambient sulfate concentrations correlate well with both SO_2 and TSP levels in air, recent EPA studies of 63 NASN stations for 1964–70 have indicated a lack of such correlations. Sulfates, for example, were not observed to have declined since 1964, as have SO_2 and TSP. In addition, short-term fluctuations in ambient SO_2 do not appear to be matched by similar variations in ambient sulfate concentrations.

Major Transportation Pollutants—The principal air pollutants produced by the automobile and other forms of transportation are carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x). Both CO and HC are emitted as the result of incomplete

Figure 17

Sulfur Dioxide Levels, 1972



Source: EPA, *Monitoring and Air Quality Trends Report, 1972* (1973), Figure 3–2.

Table 11

NASN Stations Exceeding Primary and Secondary Annual Mean and 24-Hour Maximum Standards for Sulfur Dioxide, 1964–71

Year	Number of stations	Stations exceeding primary annual mean standard [1]		Stations exceeding secondary annual mean standard [2]		Stations exceeding primary 24-hour maximum standard [3]		Stations exceeding secondary 24-hour maximum standard [4]	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
1964	18	6	33	8	44	2	11	5	28
1965	17	6	35	7	41	0	0	2	12
1966	15	5	33	9	60	2	13	5	33
1967	29	6	21	7	24	4	13	6	20
1968	74	10	14	18	24	4	5	11	15
1969	88	6	7	15	17	3	3	9	10
1970	86	3	3	8	9	1	1	3	3
1971	54	0	0	1	2	0	0	1	2

[1] Primary annual mean standard=80 $\mu g/m^3$.
[2] Secondary annual mean standard=60 $\mu g/m^3$.
[3] Primary 24-hour maximum standard=365 $\mu g/m^3$.
[4] Secondary 24-hour maximum guide=260 $\mu g/m^3$.

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quailty and Emissions Trends* (1973), Vol. 1, Table 4–10.

Table 12

Sulfur Dioxide: Ratio of Annual Mean to EPA Primary Standard in Selected Cities [1]

City	1967	1968	1969	1970	1971	1972	1973
Los Angeles	NA	NA	NA	[2] 0.14	0.26	0.30	[2] 0.23
Denver	NA	NA	0.22	0.17	0.10	0.09	[2] 0.18
Washington, D.C.	NA	NA	0.36	[2] 0.34	[2] 0.26	0.50	[2] 0.32
Chicago	NA	2.18	2.30	1.50	0.91	0.59	[2] 0.33
Boston	[2] 0.23	0.65	0.80	[2] 0.59	[2] 0.22	0.15	[2] 0.37
St. Louis	1.04	1.14	0.91	[2] 0.72	0.12	0.24	[2] 0.51
Cincinnati	NA	0.36	0.33	0.14	0.21	0.29	[2] 0.21
Philadelphia	NA	1.13	0.87	1.06	0.46	0.56	[2] 0.57
Pittsburgh	0.89	0.94	0.95	0.72	0.62	0.79	[2] 0.27
New York City	4.35	[2] 3.03	[2] 1.69	[2] 0.21	[2] 0.87	0.60	[2] 0.45

NA—Not available.

[1] A ratio of 1.00 means that the annual average ambient concentration was exactly at the level of the primary standard (80 micrograms per cubic meter, annual average).

[2] These readings do not meet EPA criteria for statistical validity, in most cases because an insufficient number of samples have been reported for the year.

Source: Based on EPA data from the National Air Sampling Network.

combustion of fuel. CO is a colorless, odorless, potentially lethal gas that combines with human hemoglobin and inhibits the blood's ability to carry oxygen. Hydrocarbons are unburned constituents of fuel. Although not normally toxic at ambient levels, HC can contribute to the formation of smog. Emissions of NO_x occur primarily when the high temperatures of combustion cause normally inactive atmospheric nitrogen to combine with oxygen. NO_x can react with HC to form ozone and other photochemical oxidants in smog. Photochemical oxidant levels in excess of the primary ambient standard (160 micrograms per cubic meter) for 1 hour can cause irritation of human eyes, impaired respiratory function in persons with bronchitis or emphysema, and increased susceptibility to respiratory diseases in experimental animals.[36]

During the past several years, emission controls on new vehicles have resulted in progressive reductions in average emissions of CO and HC per vehicle mile (Table 13). Thus far, significant reductions in average NO_x emissions have not been achieved, largely because attempts to reduce CO and HC in conventional automotive systems can actually increase emissions of NO_x. Because of the increasing number of automobiles in use, total nationwide motor vehicle emissions have increased over the past 3 decades, although the rate of increase in CO and HC began to slow somewhat in the 1960's (Table 14).

Man's atmospheric emissions of CO, produced primarily by combustion of fossil fuels in motor vehicles and stationary sources, appear to be an order of magnitude or so less than the CO produced by the earth's natural sources, which include photosynthesis, the decomposi-

Table 13

Average Nationwide Emissions per Vehicle Mile Traveled

[In grams per mile]

	1965	1970	1971	1972	1973
Carbon monoxide	89	78	74	68	62
Hydrocarbons (exhaust)	9.2	7.8	7.2	6.6	6.1
Hydrocarbons (crankcase and evaporation)	5.8	3.9	3.5	2.9	2.4
Nitrogen oxides	4.8	5.3	5.4	5.4	5.4

Source: Environmental Protection Agency. *Monitoring and Air Quality Trends Report, 1972* (1973), Table 4–13.

tion of organic matter, the atmospheric oxidation of methane, forest fires, and other processes.[37] However, these natural sources of CO do not normally produce local concentrations that are hazardous to human health. CO is the major gaseous air pollutant produced by man on the basis of weight, and motor vehicle emissions of CO are known to present serious health hazards in areas of heavy urban traffic.

Nationwide, total estimated controllable emissions of CO more than doubled between 1940 and 1970 (Table 15). The average yearly increase in CO from motor vehicles had been about 4 percent, although progressively improving auto emissions controls since 1968 have more recently reduced this rate of increase.

In spite of the nationwide increases in emissions, a recent EPA study of five cities has reported that average ambient carbon monoxide levels generally declined between 1962 and 1971 (Figure 18). It should be noted that this study was based on Continuous Air Monitoring Program (CAMP) data, and hence measurements were limited to one site per city. Moreover, ambient urban CO levels fluctuate considerably with the time of day, local traffic conditions, and season. In addition, CAMP sampling procedures for CO were altered in 1969–70, so caution is necessary in comparing data obtained before and after those years.

Table 14

Rates of Change in Estimated Weight of Total Nationwide Emissions for Road Vehicles

[By percent per year]

	1940–60	1960–70
Carbon monoxide	4.3	3.4
Hydrocarbons	4.3	1.0
Nitrogen oxides	1.9	4.6

Source: Environmental Protection Agency, *Monitoring and Air Quality Trends Report, 1972* (1973), pp. 4–29 ff.

Table 15

Carbon Monoxide: Estimated Total Nationwide Emissions

[In millions of tons per year]

	1940	1950	1960	1970
Controllable	42.5	63.2	79.3	96.0
Total	72.5	82.9	98.6	100.7

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. 1, Table 1–5.

Although declines have been reported in CO annual averages and 8-hour primary standard violations in some cities in recent years, trends have been mixed nationwide, and some urban areas have shown recent increases. Preliminary 1973 CAMP data for Chicago, for example, show a higher incidence of 8-hour CO primary standard violations than had been observed in 1971.[38] In 1972, 42 Air Quality Control Regions reported violations of the 8-hour primary standard nationwide. Significantly, 21 of these 42 regions had previously been classified by EPA as Priority III (least severe) for carbon monoxide. CO, of course, is generally considered to be a localized pollutant, and reported violations of CO standards for a region can be caused by conditions at one monitoring site.

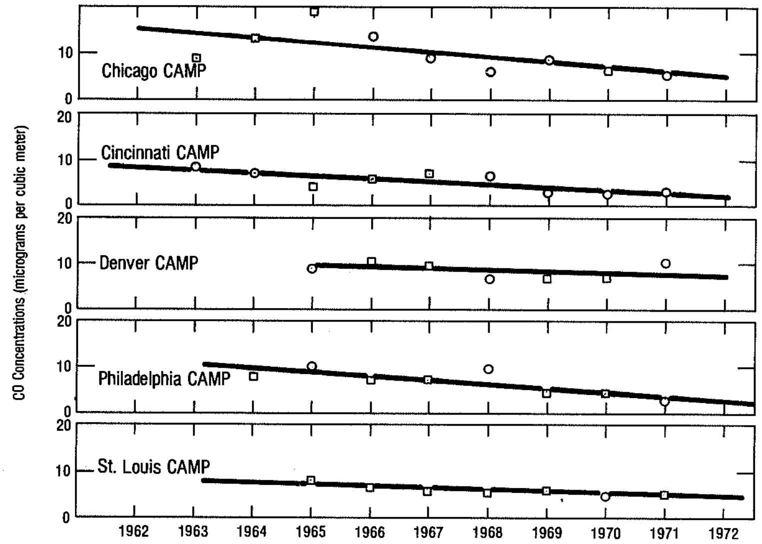
Between 1940 and 1970, total nationwide controllable emissions of hydrocarbons roughly doubled (Table 16). These HC emissions were produced not only by motor vehicles, but also by refineries, petroleum storage and processing facilities, solvent vapors, and other sources. The rate of increase for motor vehicle HC emissions alone was higher—about 3.3 percent per year over this period. Since the late 1960's, however, reduced emissions per vehicle resulting from controls on new vehicles have brought the annual rate of increase of automobile HC emissions to below the nationwide average for all sources.

Available ambient air quality data regarding HC, NO_x, and total oxidants are less satisfactory for characterizing nationwide trends than the data on other major pollutants. Moreover, there is considerable uncertainty regarding ambient levels and trends for NO_x. Although an EPA study of CAMP data for 5 cities had reported slight increases in ambient NO_x for 1962–71, the data were obtained by the Jacobs-Hochheiser method of NO_x analysis, which has been shown to overestimate ambient NO_x levels at low concentrations. Thus, these NO_x data must be viewed with caution.

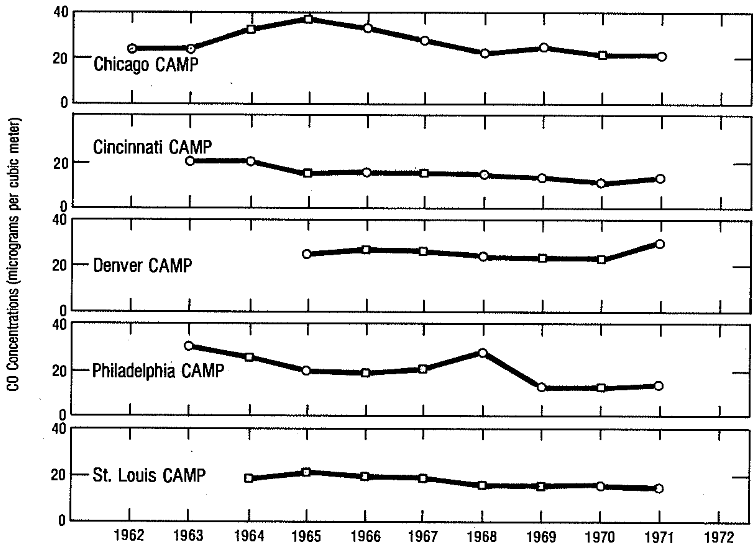
An experimental NASN program for measuring NO_x by a modification of the Jacobs-Hochheiser method was begun in 1972. It will probably be several years before this new program can provide useful trend analyses. In the meantime, EPA has suspended all Air Quality Control Region priority classifications for NO_x.

Figure 18

Trends in Carbon Monoxide Concentrations, 1961-72, Continuous Air Monitoring Program (CAMP) Cities



A. Trend lines for annual averages in five CAMP cities



B. Trend lines for annual 99th percentiles in five CAMP cities

[1]O indicates invalid average (average based on incomplete data).

Source: EPA, *The National Air Monitoring Program: Air Quality and Emission Trends (1973)*, Figures 4–14 and 4–18.

Considerable data are available on trends in NO_x emissions, however. Over the past 3 decades, total nationwide emissions are estimated to have quadrupled (Table 17). During this period, emissions from motor vehicles have increased at a steady rate of 4.6 to 4.9 percent per year. Emissions from stationary sources, however, have contributed progressively increasing proportions (Table 18). Total NO_x emissions from power plants have increased at an annual rate of 6.9 to 7.4 percent.

Table 16

Hydrocarbons: Estimated Total Nationwide Emissions

[In millions of tons per year]

	1940	1950	1960	1970
Controllable	10.1	15.6	18.8	22.5
Total	16.6	21.8	25.8	27.3

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. 1, Table 1-5.

Table 17

Nitrogen Oxides: Estimated Total Nationwide Emissions

[In millions of tons per year]

	1940	1950	1960	1970
Controllable	5.5	8.2	10.9	22.0
Total	6.5	8.8	11.4	22.1

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. 1, Table 1-5.

Table 18

Nitrogen Oxides: Rates of Change in Estimated Weight of Total Nationwide Emissions for Selected Source Categories

[By percent per year]

	1940-60	1960-70
Road vehicles	4.9	4.6
Fuel combustion (stationary sources)	2.0	7.3
Steam electric utilities	6.9	7.4

Source: Environmental Protection Agency, *The National Air Monitoring Program: Air Quality and Emissions Trends* (1973), Vol. 1, p. 1-12.

Impacts of the Energy Shortages

The reduced use of motor vehicles is reported to have had positive effects on air quality in some cities. Although the available evidence does not yet enable confident conclusions to be drawn, preliminary reports from New York City and Portland, Oregon, suggest that ambient carbon monoxide (CO) levels in the center city were reduced during the most severe months (winter, 1973–74) of the recent gasoline shortages. At some Manhattan traffic intersections, ambient CO was reported to be 10 to 30 percent below levels of the previous winter.[39] These reductions were mostly observed at non-rush-hour times and at intersections where use of private vehicles predominates. No significant changes in CO levels were observed during peak rush-hour traffic or on streets heavily used by taxis, buses, and trucks, which were apparently less affected by the gasoline shortage than the discretionary use of private vehicles.

Significant reductions in CO levels last winter also were reported for downtown Portland, Oregon.[40] In comparison with the previous two winters, ambient CO values for Portland were lower by 10 to 25 percent. During the same period, average daily traffic was about 10 percent below normal, gasoline sales were estimated at 20 percent below normal, and public transit usage was approximately 20 percent above normal.

Although these reports of reduced levels of ambient CO in urban areas probably reflect in part the influences of improved automotive emissions controls and varying meteorological conditions, the CO reduction appears to be substantially greater than any which could be attributed solely to these influences.[41] Gasoline shortages appear to have been a major factor in the observed reductions. If these preliminary analyses are supported by evidence from other cities, then one effect of the recent gasoline shortages will be to reinforce the concept that transportation plans for reducing use of private vehicles in urban areas can be of great help in achieving ambient air quality standards.

The use of fuels with higher sulfur content appears to have had some undesirable impacts on air quality. Chapter 2 describes the issuance of variances to increase the permissible sulfur content of fuels used by stationary sources. Complete analyses of the impacts of these variances on ambient air quality are not yet available. However, Philadelphia has reported that a marked upward trend in ambient sulfur dioxide (SO_2) occurred soon after a number of fuel sulfur variances were granted in the winter of 1973–74 (Figure 19). This upward trend is based on a preliminary analysis which employed 12-month moving averages [42] of October-through-April data from both city and Federal monitoring sites in downtown and residential areas of the city. Although meteorological influences have not yet been analyzed, it is noteworthy that during similar months of the previous

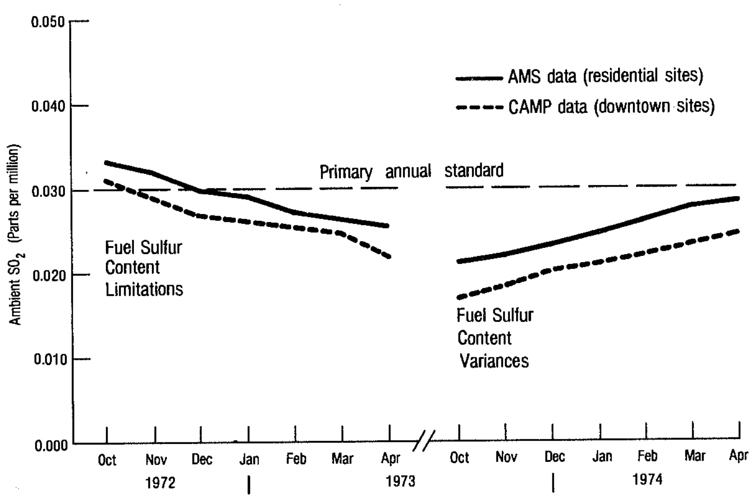
year, a downward trend had formerly been observed (see Figure 19), following implementation in late 1972 of a city regulation that had limited the maximum permissible sulfur content in fuel to 0.5 percent.[43]

In another study, EPA is examining the impact of fuel sulfur variances on ambient SO_2 levels measured at 21 air monitoring sites in the New York City-northern New Jersey area.[44] Comparisons of the winter of 1973–74 with that of the previous year suggest that ambient SO_2 increased at most of the monitoring sites near large stationary sources that had received variances. Increased SO_2 levels were not observed at sites that are influenced mostly by residential space heating emissions, thus possibly reflecting the effects of energy conservation.

The data analyzed thus far are not sufficient to permit confident general conclusions to be drawn about the nationwide air quality impacts of the gasoline shortages, fuel sulfur variances, conversions from oil to coal, or other effects of the Nation's energy shortages of 1973–74. During the coming year, however, a more precise picture of the air quality impacts of the energy shortages should become available.

Figure 19

Philadelphia: Fuel Sulfur Content Vs. Ambient Sulfur Dioxide (12-Month Moving Averages)



Source: Based on data from Air Management Services, City of Philadelphia, Pa.

Limitation of Knowledge and Methods

The important gaps in our knowledge about air quality involve both the methods by which we measure it and also the information base on which we rely to set protective standards. One of the most important considerations in the interpretation of ambient air quality trends is that most measurements do not by themselves reveal the influence of meteorological factors. Since most monitoring is conducted at a limited number of fixed locations, our interpretations of the data must be undertaken with an appreciation of the complex dynamics of the atmospheric systems being measured.

The transport and dispersion of man's air pollutant emissions are determined by factors such as wind speed and direction, atmospheric turbulence, and rainfall. Some pollutants undergo chemical reactions in the atmosphere, forming secondary pollutant compounds under the influence of sunlight, temperature, humidity, and other factors. In addition to influences of major weather systems, complications are introduced by the structure of urban areas. Cities influence their own climate. Local atmospheric conditions are affected by buildings and other structures arranged in various heights and patterns, the properties of materials used in their construction, and the paved areas surrounding them. There also are regional similarities and differences in meteorological patterns. These include factors that importantly influence the behavior of air pollutants, such as the frequency of low-level, stable air inversions, the daily patterns of vertical air mixing, and the incidence of light winds.

These factors, which can vary regionally and locally, seasonally and daily, affect the dispersal and reactivity of emitted air pollutants and thus affect the air quality measurements made at individual monitoring sites. It is therefore extremely difficult to assess the effects of pollution control strategies, and the interpretation of air quality trends must be made cautiously in this context. At the same time, our monitoring methods and plans must be continuously evaluated and improved in order to provide the information needed for control strategy decisions. Moreover, the need for improvements is not limited to the major pollutants (TSP, SO_2, CO, HC, NO_x, O_x), toward which most monitoring is presently addressed. As discussed earlier, we need to improve our abilities to characterize ambient sulfates and other chemicals associated with fine particulate matter, including toxic substances such as lead, zinc, mercury, cadmium, and organic carcinogens.

Also needed are improvements in the knowledge base by which protective standards are developed. Although the present national ambient air quality standards are based on the results of a considerable amount of research, these standards have necessarily relied upon a number of assumptions and educated conjectures. In establishing primary air quality standards for the protection of human health, much information has been available about the health effects of

exposure to undesirable levels of particulate matter, sulfur oxides, carbon monoxide, nitrogen oxides, photochemical oxidants, and other pollutants.[45] Exposure to high enough levels of these pollutants for sufficient time has been experimentally or statistically associated with discomfort and irritation of the eyes and respiratory tract; reduced capacity for physical activity; impaired respiratory, cardiac, and mental function; aggravation of the symptoms of cardiac disease, and of asthma, bronchitis, and other respiratory illnesses; increased incidence of such illnesses; and many other effects, including increased mortalities, especially of infants, the elderly, and the seriously ill.

At the same time, the presently available data on such health effects involve many uncertainties. For the most part, these data do not enable the accurate identification of pollutant levels which constitute the "lower limits" for producing such effects. Rather, most such levels have necessarily been estimated, often somewhat crudely, and possibilities exist that some present ambient standards may be set too high. Secondary effects, including damage to property and vegetation, are even less well understood.

Additional information is seriously needed on the synergistic relationships of SO_x with oxidants, particulate matter with SO_x, and other combinations. The health effects of sulfates and fine particulates also need further study. Many questions regarding concentration vs. duration of exposure remain largely unanswerable at present. There also is a need for additional basic information on the adverse impacts of sulfur oxides and other air pollutants upon vegetation, soil nutrients, and aquatic ecosystems, including both long-term ecological impacts and effects on agricultural and forest production capacity.

The limitations on our knowledge about the effects of air pollution, as well as other difficulties in obtaining accurate, representative measurements of ambient air quality and emissions, affect not only the confidence with which protective ambient air quality standards are designated, but also our abilities to interpret the significance of trends observed. Although we have evidence that some air quality improvements have occurred in recent years, there also is an understandable and appropriate tendency to stress new problems and areas of uncertainty as they are recognized and investigated. At the same time, the fact should not thereby be obscured that the considerable efforts and resources that have been devoted to air pollution control in recent years have achieved some improvements in our Nation's air quality, especially in comparison with what might have occurred in the absence of such controls.

Water Quality

The assessment of nationwide trends in water quality is even more difficult than measuring air quality trends. The Nation's waters are diverse, ranging from small streams and ponds to major rivers,

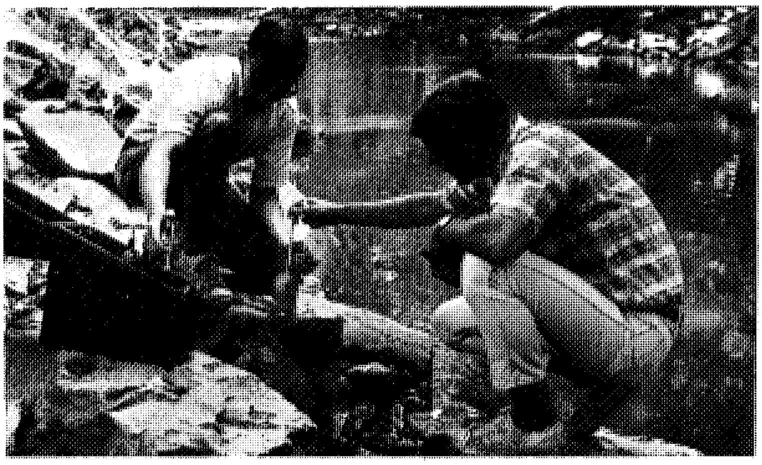
the Great Lakes, estuaries, and coastal waters. They serve a variety of uses, including domestic and industrial water supply, irrigation, transportation, wildlife habitat, and recreation. The air, by contrast, is relatively uniform in composition across the Nation. Although air pollution can damage vegetation, soils, materials, and natural ecosystems, the air obviously has one principal human use. Moreover, the number of pollutants which are known to affect water quality significantly is greater than the number of major air pollutants.

Water Monitoring

The 1972 Amendments to the Water Pollution Control Act have required comprehensive redirections in the monitoring of the Nation's water quality. In January 1974, for example, EPA began implementation of the National Water Quality Surveillance System, designed to provide long-term base information on trends in water quality.

The system consists of 60 pairs of stations and 30 single stations sited on various U.S. waterways. These paired stations will be located upstream and downstream of areas of special interest, such as cities or agricultural regions, in order to monitor changes in water quality due to contributions of both point and non-point sources. Physical and chemical parameters, including pesticides and metals, will be measured at these paired stations. Biological and sediment analyses may also be included. Within a few years, this system should provide a record of fluctuations in water quality that is potentially indicative of national trends.

The U.S. Geological Survey (USGS) has also established the National Stream Quality Accounting Network, a nationwide array



Effective water quality protection depends upon adequate monitoring data.

of stations for continuous sampling and periodic assessment of U.S. stream quality. As of early 1974, approximately 100 monitoring stations were included in this network, about half of which are also part of EPA's National Water Quality Surveillance System. Approximately 525 stations have been scheduled by USGS for inclusion in the network by 1976. The preliminary findings of the first attempt at a nationwide water quality assessment using the USGS network were summarized in CEQ's 1973 Annual Report. The Geological Survey is presently completing this assessment.

Water Quality Analysis

Recently, EPA completed its 1974 National Water Quality Inventory Report to Congress.[46] This study was the first attempt of its kind at a systematic nationwide inventory. Although the methodology required certain assumptions, the study resulted in an interesting overview of water quality trends from 1963 to 1972.

The study analyzed trends in water quality for the Nation's 10 longest rivers, the 10 rivers with highest average rates of flow, and the waterways on which the Nation's 10 largest urban areas are located. Because these categories overlap in part, the total number of waterways studied was 22 (Figure 20). These 22 waterways drain

Figure 20

Major Waterways Studied by EPA

Source: EPA, *National Water Quality Inventory:* Report to Congress (1974).

approximately 70 percent of the Nation's total land area, where about 125 million people live. (Table 19.)

The objective of the study was to integrate and interpret more than 1.2 million analytical samples regarding 88 different pollution parameters obtained by EPA, USGS, the states, and others, at 1,300 separate monitoring stations between 1963 and 1972. In order to do this, EPA adopted the following methodology. First, because of the length of some of the rivers studied, the 22 waterways were divided into a total of 35 reaches. Second, for each water quality parameter, the concentration in a reach was characterized by averaging the median (middle) values from each monitoring station on that reach for which adequate data were available. Measurements of all 88 parameters were not available at every station. Where measurements were available, each station's median value was given equal weight. General trends were determined by comparing the composite values of the 5-year period 1963–67 with the period 1968–72. Seasonal variations were characterized by comparing winter (January–March) with summer (June–October) values.

The results of the study were summarized in two ways. First, the number of reaches was determined in which the composite value for each water quality parameter improved or became worse between the two 5-year periods. Second, these composite values were compared to water quality criteria or reference levels associated with

Table 19

Major U.S. Waterways

10 longest rivers (miles)	10 rivers with highest flows (cubic feet per second)	Waters of 10 largest urban areas
Missouri (2,564)	Mississippi (620,000) [1,2]	Hudson River—New York Harbor
Mississippi (2,348)	Ohio (255,000) [1]	Los Angeles Harbor
Rio Grande (1,885)	Columbia (235,000) [1]	Lake Michigan and other waters of Chicago area
Yukon (1,875)	Missouri (70,100) [1]	Delaware River (Philadelphia)
Arkansas (1,450)	Tennessee (63,700)	Detroit River and Detroit area tributaries
Colorado (1,450)	Alabama-Coosa (59,000)	San Francisco Bay and Sacramento River
Columbia-Snake (1,324)	Red (57,300) [1,3]	Potomac River (Washington, D.C.)
Ohio (1,306)	Arkansas (45,200) [1]	Boston Harbor
Red (1,222)	Susquehanna (35,800)	Ohio River (Pittsburgh) [1]
Brazos (1,210)	Willamette (30,700)	Mississippi and Missouri Rivers (St. Louis)[1]

[1] Contained in first (or second) columns.
[2] Includes Atchafalaya River (about 25 percent of flow).
[3] Includes flow of Ouachita River.

Source: Environmental Protection Agency, *National Water Quality Inventory: Report to Congress* (1974), Table I-1.

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water quality protection. The percentages of all reaches exceeding these reference levels were computed.

This analysis of overall composite averages of various water quality parameters should be interpreted with caution, since the methodology involves several important assumptions and limitations. First, it assumes that a broad overview can be obtained by averaging the data from many local monitoring stations on a river. Such an approach may help to characterize river quality in broad terms—assuming the data themselves are representative of conditions—but it obviously does not attempt to portray local conditions accurately. Erroneous conclusions could be reached if results of the broad analysis were applied locally.

The analysis further implicitly assumes that methodological inconsistencies and time variations in collection of the data did not produce a bias in the trends observed. EPA recognizes that monitoring and data collection practices have changed over the 10-year period studied but has no real evidence that these changes occurred in ways that would significantly bias the conclusions. In interpreting the results of this study, it should also be recognized that average values for water quality parameters are only one method of examining conditions and trends. It is well known that maximum and minimum values for most parameters are usually of greater ecological significance than average values. Although the EPA study provided information on the ranges of values for most parameters, these ranges were not amenable to summary table comparison in this report.

As a test of the validity of the analysis, and to obtain a better understanding of local water quality problems, EPA studied 7 of the 22 rivers in detail and found that the conclusions of its overview study were generally supported. Furthermore, even though any generalized aggregation of data may be subject to some misinterpretation, such overviews can provide useful information and should not be avoided solely because of their lack of high resolution. For the type of overview sought, the EPA approach seems reasonable.

The results of the study are summarized in Tables 20 and 21. For each parameter, Table 20 shows the percentage of reaches that improved in 1968–72, as compared to 1963–67. Table 21 shows the percentage of the reaches where the average parameter values exceeded reference levels developed from water quality criteria or research data. It should be noted, however, that the reference level for any parameter can be exceeded—even frequently—in reaches where the *average* concentration is below the reference level. It should be noted also that nationwide average improvements do not preclude specific local cases of worsening conditions. Conversely, nationwide average deteriorations do not preclude specific local cases of improvement.

The most disturbing trend regards nutrients. Up to 84 percent of the reaches exceeded phosphorus and phosphate reference levels associated with potential eutrophication, and up to 54 percent of the

Table 20

Major Waterways: Water Quality Trends, 1963–72[1]

Parameter	Number of reaches analyzed	Percent of reaches improved [2]
Suspended solids	28	82
Turbidity	29	79
Fecal coliforms (membrane filter)	9	78
Ammonia	25	76
BOD_5	31	74
Total coliforms (membrane filter delayed)	23	70
COD	20	70
Temperature	33	67
Total coliforms (most probable number)	9	67
Dissolved solids (105° C)	28	64
Chlorides	34	62
Dissolved oxygen	31	[3] 61
Dissolved solids (180° C)	23	61
Odor	5	60
pH	34	[4] 59
Total coliforms (membrane filter immediate)	12	58
Phenols	12	58
Dissolved phosphate	18	56
Sulfates	33	55
Organic nitrogen	11	55
Total phosphate	16	44
Alkalinity	32	[3] 41
Nitrite	5	40
Nitrite plus nitrate	27	37
Color	30	33
Nitrate (as NO_3)	19	26
Nitrate (as N)	17	24
Total phosphorus	28	18

[1] Based on median values at each reach. Reaches included only if they contain one or more stations with at least 7 samples each. Parameters included only if 5 or more reaches were measured.

[2] Except where noted, "improved" means that 1968–72 median concentrations are lower than 1963–67 median concentrations at mean station.

[3] "Improved" means higher concentrations.

[4] "Improved" means pH becomes higher (less acid).

Source: Environmental Protection Agency, *National Water Quality Inventory: Report to Congress* (1974), Table II-2.

reaches showed increased phosphorus levels in 1968–72 over the previous years. Nitrate levels also increased in 74 percent of the reaches examined. Approximately one-fourth of the reaches exceeded nitrate reference levels. In more detailed studies of the Mississippi, Missouri, Ohio, Tennessee, and Columbia Rivers, EPA found levels of phosphates and nitrates that theoretically were sufficient to support nuisance algae growth in all except the Columbia.[47]

Other pollutants with high levels were phenols (industrial compounds that can affect fish palatability and cause taste and odor problems in drinking water) and suspended solids (which interfere with some aquatic life processes). These results are not as disturbing

Table 21

Major Waterways: Reference Level Violations, 1963–72

Parameter	Reference level and source[1]	Percent of reaches exceeding reference levels		
		1963–72	1968–72	Change
Suspended solids	80 mg/1-aquatic life	26	14	−12
Turbidity	50 JTU-aquatic life	28	28	0
Temperature	90°F-aquatic life	0	0	0
Color	75 platinum-cobalt units-water supply	0	0	0
Ammonia	0.89 mg/1-aquatic life	16	6	−10
Nitrate (as N)	0.9 mg/1-nutrient	12	24	+12
Nitrite plus nitrate	0.9 mg/1-nutrient	18	26	+8
Total phosphorus	0.1 mg/1-nutrient	34	57	+23
Total phosphate	0.3 mg/1-nutrient	30	41	+11
Dissolved phosphate	0.3 mg/1-nutrient	11	22	+11
Dissolved solids (105°C)	500 mg/1-water supply	25	18	−7
Dissolved solids (180°C)	500 mg/1-water supply	28	12	−16
Chlorides	250 mg/1-water supply	12	9	−3
Sulfates	250 mg/1-water supply	12	12	0
pH	6.0–9.0-aquatic life	0	0	0
Dissolved oxygen	4.0 mg/1-aquatic life	0	0	0
Total coliforms (MFD)[2]	10,000/100 ml-recreation	24	13	−11
Total coliforms (MFI)[2]	10,000/100 ml-recreation	50	30	−20
Total coliforms (MPN)[2]	10,000/100 ml-recreation	23	20	−3
Fecal coliforms (MPN)[2]	2,000/100 ml-recreation	45	21	−24
Fecal coliforms (MPN)[2]	2,000/100 ml-recreation	17	43	+26
Phenols	0.001 mg/1-water supply	86	71	−15

[1] With the exceptions that follow, reference level designations are from ***Guidelines for Developing or Revising Water Quality Standards***, EPA Water Planning Division, April 1973; for ammonia, chlorides, sulfates, and phenols, ***Criteria for Water Quality***, EPA, 1973 (Section 304(a)(1) guidelines); and for nitrate (as N), ***Biological Associated Problems in Freshwater Environments***, FWPCA, 1966, pp. 132–33.

[2] Membrane filter delayed, membrane filter immediate, most probable number.

Source: Environmental Protection Agency, ***National Water Quality Inventory: Report to Congress*** (1974), Table II-3.

as the nutrient data, however, because in most of the reaches with data, phenols and suspended solids showed improvement in the last 5 years.

Encouragingly, coliform bacteria and oxygen demand, the pollutants receiving the most widespread controls, showed general improvements in the last 5 years. Dissolved oxygen reportedly improved in 61 percent of the reaches, and oxygen-demand levels were reduced in 74 percent. Bacterial counts were lower in up to 75 percent.

The number of valid, usable measurements for heavy metals and pesticides was insufficient for inclusion in the overall analysis. Nevertheless, the data which were available showed that drinking water reference levels for cadmium, lead, mercury, iron, and manganese were exceeded by one or more samples collected over the 1968–72

The effectiveness of the nation's water quality efforts will be measured not only by achievements in improving polluted waterways, but also by whether we succeed in preventing degradation of valuable resources such as beautiful Lake Winnipesaukee in New Hampshire.

period in more that half of the reaches examined, and that 9 pesticides were found to exceed reference levels in more than half of the reaches.

In interpreting the EPA study, it must be recognized that concentrations of nutrients, dissolved oxygen, and many other water quality parameters characteristically fluctuate with the season, the flow rate, the temperature, and other influences. Although the EPA analysis did not focus on these fluctuations in detail, some seasonal and hydrological analysis was performed for 30 reaches. Twenty of these reaches had higher flows in winter, and 10 in summer.

This analysis found mixed seasonal trends. More waterway reaches exceeded reference levels for average suspended solids, dissolved solids, nitrates, and phenols in winter than in summer. Coliform levels, however, exceeded reference levels more often in summer. In the warmer months, higher temperatures appeared to be most often associated with higher oxygen demand levels. Yet BOD, COD, and nutrient levels generally were higher in winter, reflecting in part the lower activity of microbial degraders and algae at colder temperatures. Suspended and dissolved solids and turbidity were most frequently related to high flow rates.

In summary, the EPA study provides a mixed picture regarding trends in water quality. For oxygen demand and bacteria, progress is evident. With regard to nutrients, the disturbing trends reported in our 1972 Annual Report appear to have been confirmed. Still limited data on metals and pesticides also give cause for concern. These indications of trends should be interpreted with caution, but the find-

ings with regard to increased nutrients are clear enough to indicate that this difficult problem requires increased attention.

Phosphate Control

In contrast to the worsening trends in nutrients outlined above, recent data appear to indicate some promising results from the reduction of certain types of point-source phosphate loadings. For example, total and soluble phosphorus levels measured in the Detroit River, near its entrance to Lake Erie, have decreased dramatically since the late 1960's, reflecting reduced municipal loadings (Tables 22 and 23).

Phosphate entering the Nation's waters as a result of detergent use has also been reduced in particular locations. In recent years, a number of states, counties, and cities have enacted or considered laws to limit the phosphate content of detergents. In Indiana, one such law limited detergent phosphate content by weight to 8.7 percent after January 1, 1972, and 0.5 percent after January 1, 1973. On the basis of preliminary monitoring data from the State Division of Water Pollution Control,[48] it appears that this law has had pronounced effects on the phosphate content of municipal sewage (Figure 21). Although other influences such as streamflow and source locations must be considered, Indiana's water quality monitoring data also show marked reductions in phosphate levels in the state's streams during the same years (Figure 22).

Similar results were reported in a recent study done in Erie County, New York.[49] After the county had limited the allowable phosphate

Table 22

Detroit River (River Mile 3.9), Average Total and Soluble Phosphorus, 1966–73

[In milligrams per liter]

Year	Total phosphorus	Soluble phosphorus
1966	NA	0.309
1967	NA	0.175
1968	0.186	0.072
1969	0.144	0.083
1970	0.133	0.062
1971	0.067	0.036
1972	0.079	0.029
1973	0.058	0.015

NA—Not available.

Source: Michigan Water Resources Commission, *Annual Report to International Joint Commission* (average concentrations computed from 10 sampling stations crossing the river).

Table 23

Detroit River (River Mile 3.9), Distribution of Total Phosphorus, 1968–72

[In milligrams per liter]

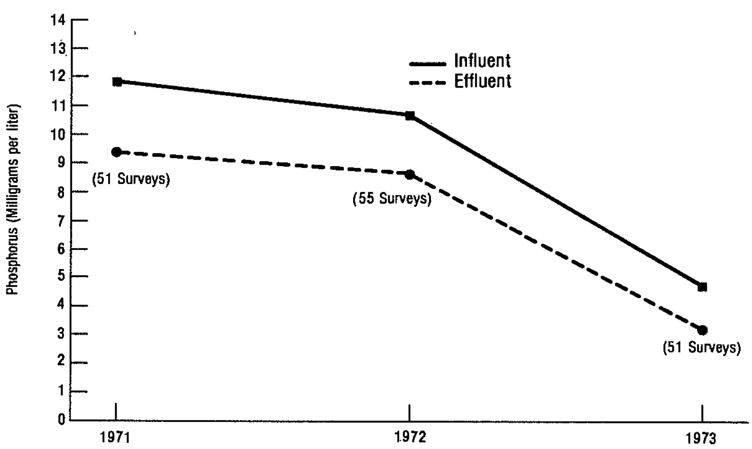
Year	Distance from Michigan shore			
	2,500 feet	5,500 feet	7,500 feet	9,500 feet
1968	0.62	0.22	0.16	0.15
1969	0.58	0.21	0.13	0.08
1970	0.27	0.15	0.16	0'09
1971	0.22	0.15	0.09	0.06
1972	0.16	0.11	0.12	0.05

Source: Michigan Water Resources Commission, *Annual Report to International Joint Commission* (average concentrations computed from 10 sampling stations crossing the river).

content of detergents to 0.5 percent as of January 1, 1972, the average phosphorus levels in sewage, measured at five treatment plants, were reportedly cut roughly in half. In samples taken at 164 water quality monitoring stations in the county, reductions of similar magnitude in stream phosphate levels were observed in the summer of 1972. Reductions did not occur at remote stations selected for "control" comparison.

Figure 21

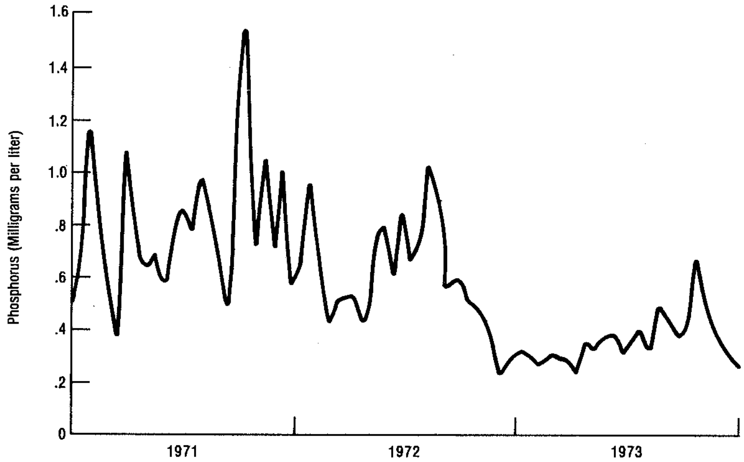
Summary of Phosphorus Concentrations, 24-Hour Surveys of Municipal Sewage Treatment Plants, Indiana, 1971-73



Source: Indiana State Department of Health, Division of Water Pollution Control.

Figure 22

Combined Monthly Average Phosphorus Concentrations for Water Quality Monitoring Stations, Indiana, 1971-73



Source: Indiana State Department of Health, Division of Water Pollution Control.

Projecting the Generation of Pollution

In recent years the Nation has undertaken major programs with significant impacts upon the environment and the economy, such as the implementation of the Clean Air Act and the Federal Water Pollution Control Act, and the current planning for America's energy future under Project Independence. The fact that very few analytical tools were available for rapid, systematic, and comprehensive assessment of the impact of such programs has been a barrier to their implementation.

Fortunately, in the past year several analytical tools have been developed which will facilitate such assessments. This section will describe two of them.[50] The first, called SEAS (Strategic Environmental Assessment System), was developed by the Environmental Protection Agency and became operational at the beginning of this year in prototype form. It is a comprehensive model which projects the generation of environmental residuals and the cost of their abatement.[51] The second is MERES (Matrix of Environmental Residuals from Energy Systems), a program developed under the direction of the Council on Environmental Quality in association with other government agencies. It permits an assessment of the residuals generated

by the extraction, processing, transportation, conversion, and use of different energy sources.

Both of these analytical tools are still in their formative stages and are presently being tested, expanded, verified, and documented. Nevertheless, an examination of some of the preliminary results shows how they can assist decisionmakers in assessing policies. The results presented here represent some of the first outputs of the two systems and should be viewed only as indications of the type of information they will provide, not as CEQ projections.

The Economy and Pollution

The SEAS Model—SEAS is a system of special-purpose models linked to an input-output model of the United States economy (INFORUM) which models the interactions between 185 different economic sectors.[52] This economic model analyzes the implications of assumed economic projections (see Table 24) in terms of the amount of activity which is expected in each of the major economic sectors. Some of the other models presently linked to INFORUM (see Figure 23) are:

- A residual generation model which estimates the annual emissions of air and water pollutants and solid wastes for the most significant polluting industries. The model estimates both emissions before abatement, which depend upon the level of economic activity, and the pollutants actually reaching the environment, which depend upon the degree of pollution abatement in each sector.
- An abatement cost model which estimates the investment and operating costs associated with controlling the emissions of air and water pollutants.

Table 24

SEAS Base Case: Economic Projections

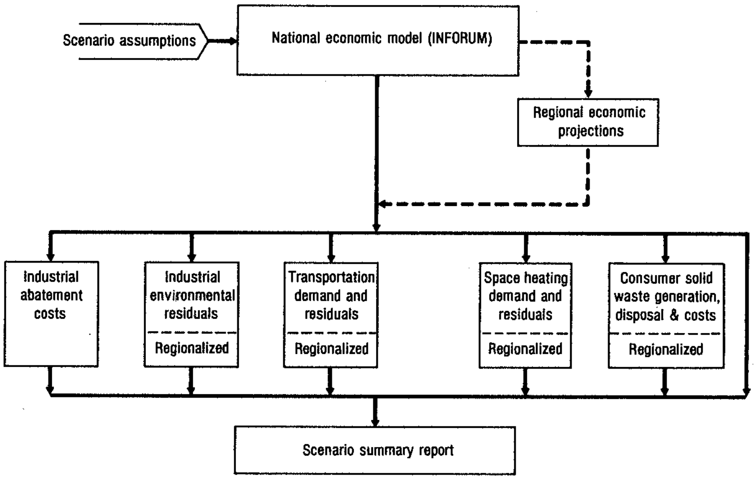
[In billions of 1971 dollars]

	Actual 1971	Base case projections	
		1980	1985
Gross National Product	1,040	1,640	1,870
Government expenditures	230	320	353
Private investment	149	258	287
Personal consumption	661	1,032	1,215
Population (millions)	207	224	236

Source: Economic projections were scaled to approximate projections made by the U.S. Department of Labor, Bureau of Labor Statistics. See Ronald Kutscher, "Projections of GNP, Income, Output, and Employment," *Monthly Labor Review*, 96: 3–42, December 1973.

Figure 23

The SEAS Prototype System



- A transportation model, which estimates intracity and intercity transportation demand for autos, buses, railroads, and airplanes, and the resulting air pollutants generated.
- A space heating model, which estimates demand for fuels used for residential and commercial heating and the amount of resulting air pollutants emitted.
- A consumer solid wastes model, which estimates the amounts of solid wastes from nonindustrial sources, the expected disposal method, and the associated costs.

By varying the assumptions about such factors as labor force participation, economic growth, patterns of consumer demand, and implementation of pollution control programs, SEAS can be used to test the implications of assumptions about the future state of our economy and national environmental policies. For the purpose of demonstrating the value of SEAS, CEQ and EPA jointly undertook a series of test runs using alternative assumptions about the implementation of national environmental and energy policies.

Impact of Environmental Regulations—Several scenarios were run with SEAS to test the impact of current environmental regulations on projected pollution emissions. The results with respect to total air and water pollution emissions are shown in Figure 24.

Three emission levels are shown for each major pollutant from 1971 through 1985. The dotted line, "uncontrolled" emissions, indicates projected emission levels if no pollution abatement whatsoever were undertaken. This is not a realistic condition, but it does pro-

Figure 24

The Base Case of SEAS: Generation of Environmental Residuals
(1971 Emissions = 100)

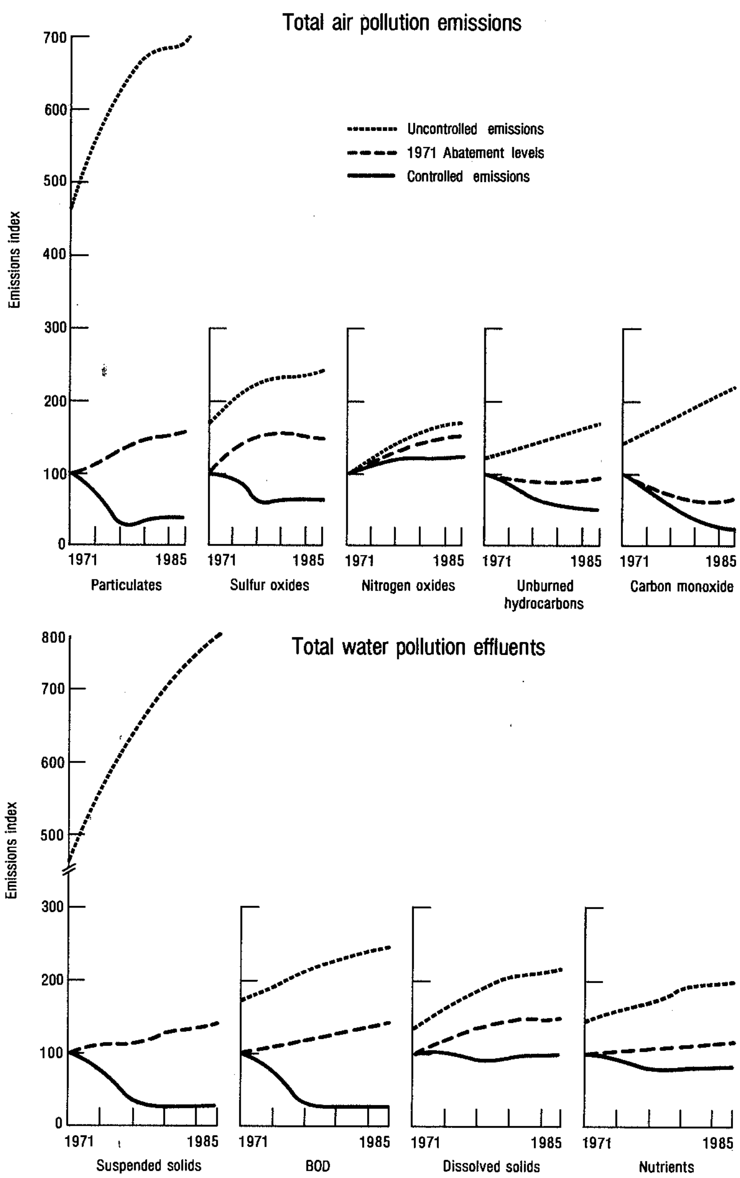


Figure 26

The Base Case of SEAS: Regional Distribution of Population and Environmental Pollutants, 1971 and 1985[1] (as a percent of national emissions)[2]

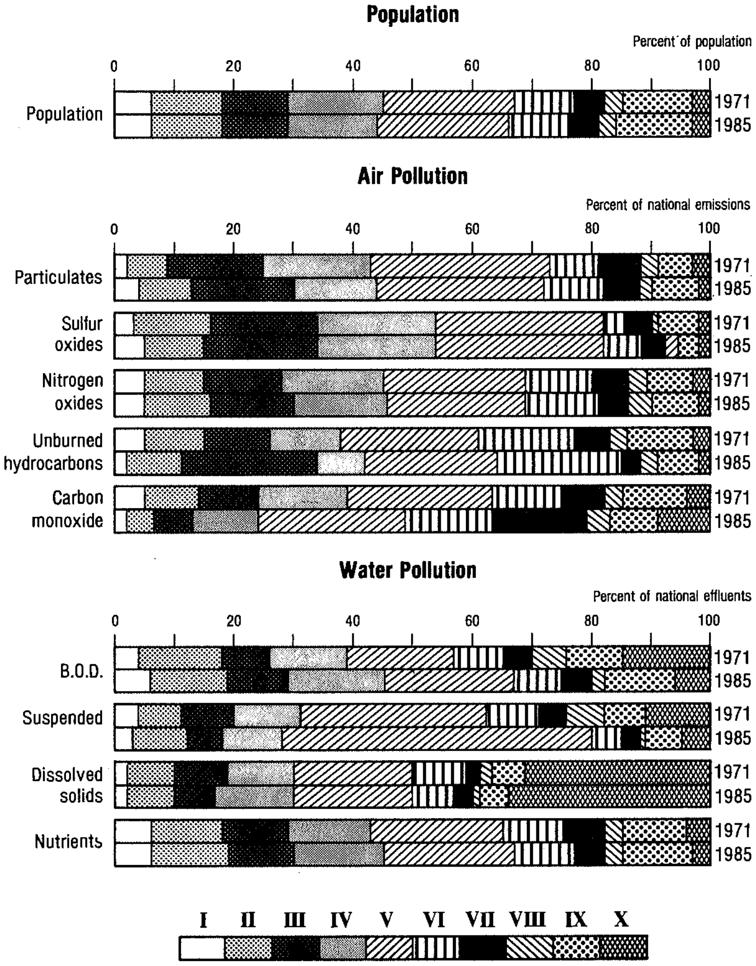
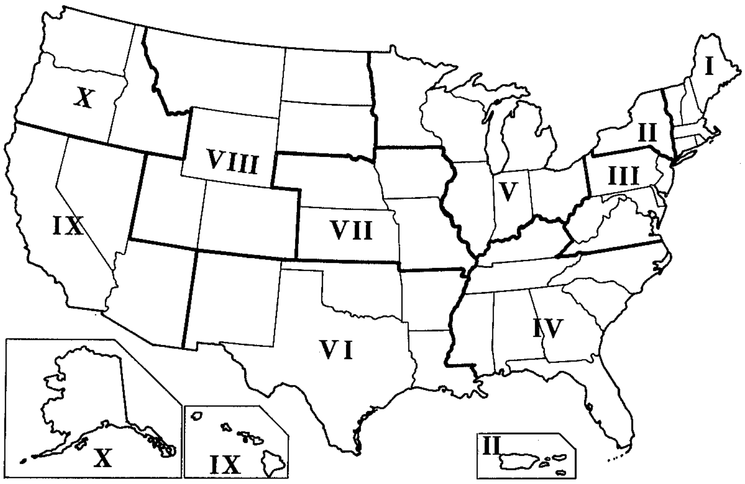


Figure 27

Federal Administrative Regions



oxides, and to become less significant than stationary sources (industries and electric utilities) as a source of nitrogen oxides and unburned hydrocarbons.[54] Stationary sources are projected to decrease their emissions of particulates and sulfur oxides substantially as the 1977 standards are met. After 1977, emissions will increase again as the economy expands.

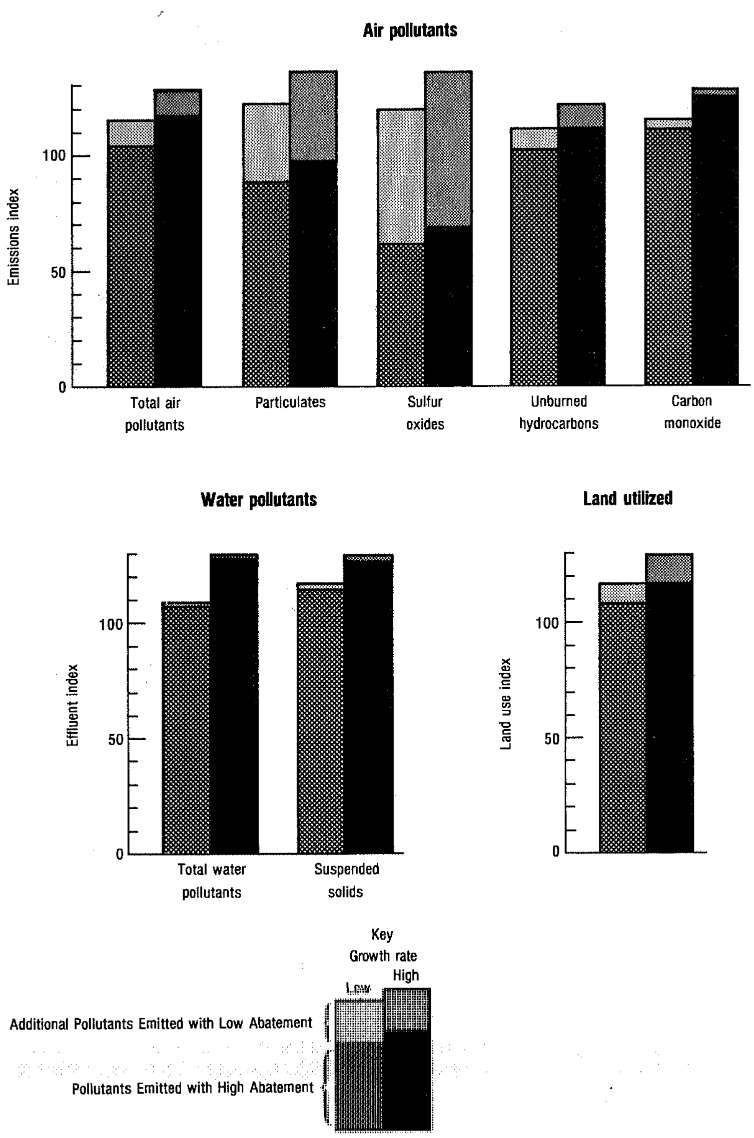
The lower section of Figure 25 similarly compares controlled and uncontrolled effluents from municipal sewage systems and major industrial sources (including electric utilities). Municipal sewage treatment effluents are projected to account for virtually all of the "controlled" nutrients and 70 percent of the dissolved solids. Abatement of BOD and suspended solids is projected to be similar in both sectors.

SEAS also has the capability to estimate the geographical distribution of pollution.[55] Figure 26 shows the distribution of population and annual expected pollutant loads of the 10 Federal administrative regions for 1971 and 1985.

In almost all pollutants, Region 5, the northern Midwest, emits the largest volume of pollutants, and its share of national emissions is generally larger than its share of the population. Taken together, the four western regions have a disproportionate share of water effluents in 1971, but by 1985 their share of BOD and suspended solids is closer to their share of the population. In the three northeast regions, the shares of most air and water pollutants are lower than their share of the population, but by 1985 their shares of most air emissions and of BOD are increased in comparison to other regions.

Figure 29

MERES Test Run: Generation of Environmental Residuals, 1978[1]
(1971 Emissions = 100)



[1]The index numbers are based on the MERES analysis of aggregate environmental effects associated with the 1971 energy budget.

Table 26

SEAS Energy Conservation Analysis, 1971 and 1985

[In quadrillion BTUs]

	1971 actual	1985	
		SEAS base case	With energy conservation
Household/commercial	24.3	39.4	30.3
Industrial	27.6	55.2	40.2
Transportation	17.0	31.1	21.9
Total	**68.9**	**125.7**	**92.4**

Thirteen stringent energy conservation measures thought to be the measures most likely to reduce substantially the recent growth rate in energy consumption were selected for analysis. These included such items as improved insulation, total energy systems for building complexes, lighter autos, increased public transit use, and changes in freight hauling patterns.[58]

Figure 30 indicates some environmental implications from these tests of energy conservation, assuming the continued implementation of environmental controls. Annual air pollutant emissions in the five major categories are reduced 12 to 26 percent. Annual water effluents change little.

Figure 30

SEAS Energy Conservation Analysis: National Air Pollution Emissions in 1985 With and Without Energy Conservation

(1971 Actual Emissions = 100)

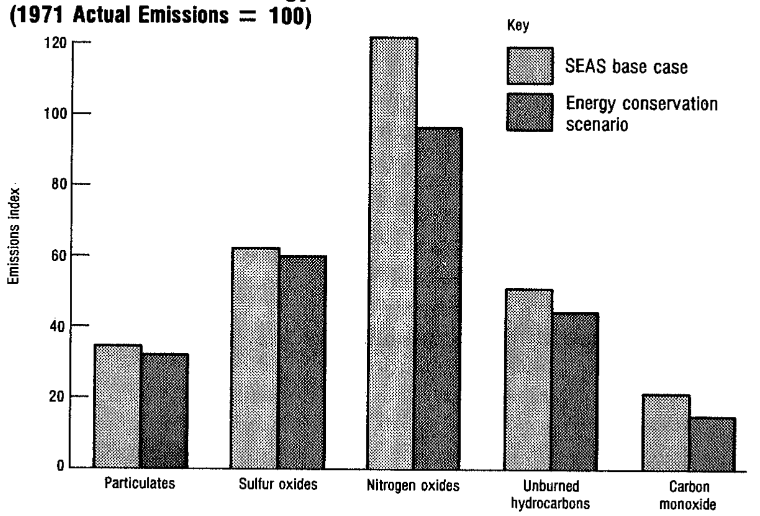


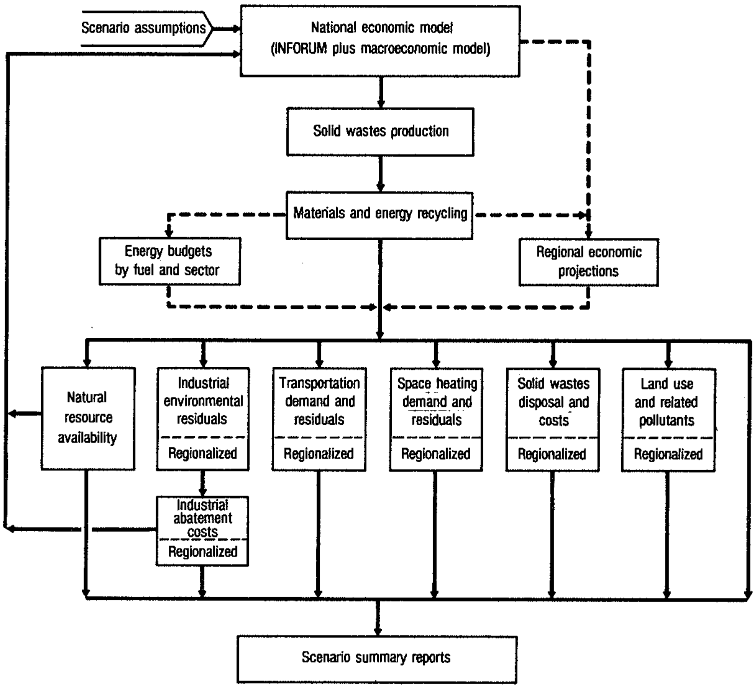
Table 28

World Cumulative Primary Mineral Demand and Resources, 1971–2000 [1]

Commodity	Units	Primary mineral demand 1971–2000			Mineral resources recoverable at 1971 U.S. prices			Ratio of recoverable resources to cumulative demand		
		United States	Rest of world	World	United States	Rest of world	World	United States	Rest of world	World
Aluminum	Million S.T.	370	680	1,050	13	2,455	2,468		3.6	2.4
Antimony	Thousand S.T.	822	2,170	2,992	110	4,390	4,500	0.1	2.0	1.5
Arsenic	Thousand S.T.	800	1,440	2,240	700	2,200	2,900	0.9	1.5	1.3
Barium	Million S.T.	31	81	112	45	65	110	1.5	0.8	1.0
Beryllium	Thousand S.T.	28	12	40	28	392	420	1.0	(*)	(*)
Bismuth	Million lb	81	251	332	10	105	115	0.1	0.4	0.3
Boron	Million S.T.	5	12	17	40	70	110	8.0	5.8	6.5
Bromine	Billion lb	12	7	19	17	8	25	1.4	1.1	1.3
Cadmium	Million lb	560	825	1,385	264	658	922	0.5	0.8	0.7
Calcium	Billion S.T.	5	19	24	(A)	(A)	(A)	(*)	(*)	(*)
Cesium	Thousand lb	350	430	780		44,000	44,000		(*)	(*)
Chlorine	Million S.T.	645	1,030	1,675	(A)	(A)	(A)	(*)	(*)	(*)
Chromium	Million S.T.	19	76	95		132	132		1.7	1.4
Cobalt	Million lb	540	1,840	2,380	56	5,404	5,460	0.1	2.9	2.3
Columbium	Million lb	288	545	833		13,000	13,000		(*)	(*)
Copper	Million S.T.	93	300	393	81	259	340	0.9	0.9	0.9
Fluorine	Million S.T.	39	101	140	6	32	38	0.2	0.3	0.3
Gallium	Thousand Kg	281	188	469	(A)	(A)	(A)	(*)	(*)	(*)
Germanium	Thousand lb	1,600	3,500	5,100	900	3,100	4,000	0.6	0.9	0.8
Gold	Million T.oz	293	1,081	1,374	82	918	1,000	0.3	0.8	0.7
Hafnium	S.T.	1,280	1,420	2,700	(A)	(A)	(A)	(*)	(*)	(*)
Indium	Million T.oz	19	56	75	11	38	49	0.6	0.7	0.7

Figure 31

Proposed SEAS Phase III System



Minerals and Materials Resources

Minerals and materials are of critical importance for economic and social development throughout the world. The petroleum shortage due to the Arab embargo focused renewed attention on the continued availability of various other resources. Certain questions were commonly asked: How adequate are world resources of other minerals and materials compared to anticipated demand? To what degree is the United States dependent on other nations to supply its needs? What is the role of recycling in extending reserves?

The term "minerals and materials" is used collectively for 80-odd basic non-living resources, including fuels, ores from which metals and alloys are produced, abrasives, sand, gravel, stone, clays, and other materials, listed in Table 28 (p. 308). It excludes agriculture and forest products, such as foods, timber, and paper.

Several in-depth analyses of how possible shortages of minerals and materials may limit growth have recently been made by groups such as the Club of Rome and the National Materials Policy Commission. This section will present available data on domestic and

to meet cumulative world demand at least to the year 2000 and generally for many years more. This group includes many important items, such as aluminum, chlorine, chromium, iron, magnesium, nickel, platinum, coal, and oxygen. However, reserves are not presently adequate for 25 commodities including copper, lead, zinc, tin, natural gas, and petroleum. Past experience suggests that the possible shortage of such items will probably be forestalled by discoveries of more reserves, rising prices, development of new technology, recycling, and substitution of other commodities. World demands could, however, become much greater if developing countries were to increase their standard of living substantially; and this, of course, is a valid goal.

Generally, most resources will be adequate until the year 2000, especially if prices rise. As prices rise, demand will be curbed, and efforts to conserve, to recycle, and to use substitute materials will be increased. That prices will rise seems rather certain.

Much materials production depends heavily upon the use of energy for earth moving, mining, and transportation. Many products are made at high temperatures, requiring copious amounts of heat. Thus, the recent sharp rise in costs of all fuels will certainly increase the costs of making many minerals and materials available. Further, as new technologies are developed to exploit lower-grade ores, more energy is generally required to process the larger amounts of ores containing lower concentrations of desired minerals. It may also become necessary to introduce new operations which consume more energy and are otherwise more expensive to conduct.

Although a rise in prices will naturally curb demand, it is still a concern that there will ultimately be a limit to the practical availability of recoverable resources.

A qualitative appraisal of the sufficiency of world resources for selected mineral commodities developed by the U.S. Department of the Interior is given in Table 29. In this analysis it is presumed that the great bulk of future supplies will be drawn from the category of hypothetical resources rather than reserves.

U.S. Consumption and Imports of Minerals

In 1950, the United States consumed 2 billion tons of new minerals and materials, equivalent to 26,000 pounds per capita of population.[59] By 1972, as Figure 32 shows, about 4 billion tons (40,000 pounds per capita) were consumed. In 1972, the value of these domestic raw minerals and materials was $32 billion, imports accounted for another $4 billion, and reuse of old scrap an additional $2 billion, for a total of $38 billion. Processing increased the value to over $150 billion, to which must be added $10 billion for imports of processed products. For comparison, the GNP was $1,152 billion in 1972. Since exports of raw and processed minerals and materials totaled $8 bil-

From the perspective of 1950, U.S. reserves appeared only sufficient to meet production needs for a 20-year period. However, despite the large amounts produced between 1950 and 1971, new discoveries, the development of new technologies, and rising prices expanded the economically accessible deposits over that period, so that reserves of 1971 were substantially higher than those of 1950. This pattern has been typical for many minerals. It gives, however, no assurance that reserves will not eventually reach an upper limit.

Economic Factors

In spite of expanding demands for minerals and materials, prices in constant dollars have not changed much over the past 15 years, with the exception of petroleum and some metals. Prices of some commodities have even declined or have fluctuated both above and below the norm. This price behavior indicates that minerals and materials technology have made an important contribution towards stabilizing prices. Availability has thus far generally kept pace with expanding use, even though in many cases reserves of lower grade had to be exploited. However, it now appears that the combination of increasing world demands, higher costs of fuels, and lower grades of reserves is beginning to overtax supplies and increase prices to a greater degree than heretofore.

Both the supply and demand for minerals and materials are highly dependent on price. Price, in turn, depends primarily on the amount available to the market at a given time. During the Arab oil boycott, for example, the price of petroleum rose dramatically even though the world's supply of petroleum in the ground remained unchanged. Price also depends on reserves, the cost to produce and market, and the demand. If the price of a mineral or material rises, a number of countervailing effects can occur: some previously subeconomic deposits may become economic reserves; new technology may be developed (or become economic, which has the same effect); or overall demand may fall, either absolutely or through substitution of an alternative mineral or material. In short, supply and demand for minerals and materials are determined by the dynamic interaction of physical availability, costs of production, availability of technology, and degree of substitutability.

A Look Ahead

Projections of the primary mineral demand for the United States and for the rest of the world to the year 2000, compared to mineral resources recoverable at 1971 prices (reserves), are shown in Table 28, prepared by the U.S. Department of the Interior. This tabulation shows that at 1971 prices reserves of 62 commodities are adequate

Table 28

World Cumulative Primary Mineral Demand and Resources, 1971–2000 [1]

Commodity	Units	Primary mineral demand 1971–2000			Mineral resources recoverable at 1971 U.S. prices			Ratio of recoverable resources to cumulative demand		
		United States	Rest of world	World	United States	Rest of world	World	United States	Rest of world	World
Aluminum	Million S.T.	370	680	1,050	13	2,455	2,468		3.6	2.4
Antimony	Thousand S.T.	822	2,170	2,992	110	4,390	4,500	0.1	2.0	1.5
Arsenic	Thousand S.T.	800	1,440	2,240	700	2,200	2,900	0.9	1.5	1.3
Barium	Million S.T.	31	81	112	45	65	110	1.5	0.8	1.0
Beryllium	Thousand S.T.	28	12	40	28	392	420	1.0	(*)	(*)
Bismuth	Million lb	81	251	332	10	105	115	0.1	0.4	0.3
Boron	Million S.T.	5	12	17	40	70	110	8.0	5.8	6.5
Bromine	Billion lb	12	7	19	17	8	25	1.4	1.1	1.3
Cadmium	Million lb	560	825	1,385	264	658	922	0.5	0.8	0.7
Calcium	Billion S.T.	5	19	24	(A)	(A)	(A)	(*)	(*)	(*)
Cesium	Thousand lb	350	430	780		44,000	44,000		(*)	(*)
Chlorine	Million S.T.	645	1,030	1,675	(A)	(A)	(A)	(*)	(*)	(*)
Chromium	Million S.T.	19	76	95		132	132		1.7	1.4
Cobalt	Million lb	540	1,840	2,380	56	5,404	5,460	0.1	2.9	2.3
Columbium	Million lb	288	545	833		13,000	13,000		(*)	(*)
Copper	Million S.T.	93	300	393	81	259	340	0.9	0.9	0.9
Fluorine	Million S.T.	39	101	140	6	32	38	0.2	0.3	0.3
Gallium	Thousand Kg	281	188	469	(A)	(A)	(A)	(*)	(*)	(*)
Germanium	Thousand lb	1,600	3,500	5,100	900	3,100	4,000	0.6	0.9	0.8
Gold	Million T.oz	293	1,081	1,374	82	918	1,000	0.3	0.8	0.7
Hafnium	S.T.	1,280	1,420	2,700	(A)	(A)	(A)	(*)	(*)	(*)
Indium	Million T.oz	19	56	75	11	38	49	0.6	0.7	0.7

Iodine	Million lb	269	733	1,002	225	2,320	2,545	0.8	3.2	2.5
Iron	Billion S.T.	3	17	20	2	95	97	0.7	5.6	4.9
Lead	Million S.T.	34	114	148	17	40	57	0.5	0.4	0.4
Lithium	Thousand S.T.	183	279	462	2,767	410	3,177	(*)	1.5	6.9
Magnesium	Million S.T.	52	186	238	(A)	(A)	(A)	(*)	(*)	(*)
Manganese	Million S.T.	50	379	429		577	577		1.5	1.3
Mercury	Thousand Fl	1,730	8,450	10,180	75	3,565	3,640		0.4	0.4
Molybdenum	Billion lb	3	6	9	6	6	12	2.0	1.0	1.3
Nickel	Billion lb	14	38	52	<1	92	92		2.4	1.8
Nitrogen	Million S.T.	1,018	2,805	3,823	(A)	(A)	(A)	(*)	(*)	(*)
Palladium	Million T.oz	24	71	95	1	228	229		3.2	2.4
Phosphorus	Million S.T.	208	722	930	39	909	948	0.2	1.3	1.0
Platinum	Million T.oz	16	88	104	1	356	357	0.1	4.0	3.4
Potassium	Million S.T.	216	787	1,003	50	21,285	21,335	0.2	(*)	(*)
Rare Earths	Thousand S.T.	452	451	903	5,045	2,665	7,710	(*)	5.9	8.5
Rhenium	Thousand lb	360	147	507	400	200	600	1.1	1.4	1.2
Rhodium	Million T.oz	2	3	5	<1	14	14		4.7	2.8
Rubidium	Thousand lb	41	35	76		2,100	2,100		(*)	(*)
Scandium	Kg	554	366	920	(A)	(A)	(A)	(*)	(*)	(*)
Selenium	Million lb	35	74	109	53	169	222	1.5	2.3	2.0
Silicon	Million S.T.	20	68	88	(A)	(A)	(A)	(*)	(*)	(*)
Silver	Million T.oz	4,400	12,000	16,400	1,300	4,150	5,450	0.3	0.3	0.3
Sodium	Million S.T.	1,160	2,990	4,150	(A)	(A)	(A)	(*)	(*)	(*)
Strontium	Thousand S.T.	771	1,390	2,161		2,372	2,372		1.7	1.1
Sulfur	Million L.T.	514	1,750	2,264	75	1,125	1,200	0.1	0.6	0.5
Tantalum	Million lb	68	70	138		101	101		1.4	0.7
Tellurium	Million lb	8	10	18	16	52	68	2.0	5.2	3.8
Thallium	Thousand lb	220	720	940	150	490	640	0.7	0.7	0.7
Thorium	Thousand S.T.	21	43	64	2	202	204	0.1	4.7	3.2
Tin	Thousand L.T.	2,000	6,480	8,480	5	4,176	4,181		0.6	0.5
Titanium	Million S.T.	32	68	100	33	132	165	1.0	1.9	1.7

See footnotes at end of table.

Table 28—Continued

World Cumulative Primary Mineral Demand and Resources, 1971-2000[1]—Continued

Commodity	Units	Primary mineral demand 1971–2000			Mineral resources recoverable at 1971 U.S. prices			Ratio of recoverable resources to cumulative demand		
		United States	Rest of world	World	United States	Rest of world	World	United States	Rest of world	World
Tungsten	Million lb	1,000	2,530	3,530	175	2,575	2,750	0.2	1.0	0.8
Vanadium	Thousand S.T.	471	727	1,198	115	10,025	10,140	0.2	(*)	8.5
Yttrium	Thousand S.T.	6	6	12	1	35	36	0.2	5.8	3.0
Zinc	Million S.T.	62	188	250	30	101	131	0.5	0.5	0.5
Zirconium	Million S.T.	4	6	10	4	6	10	1.0	1.0	1.0
Asbestos	Million S.T.	43	195	238	9	142	151	0.2	0.7	0.6
Clays	Billion S.T.'	3	16	19	(A)	(A)	(A)	(*)	(*)	(*)
Corundum	Thousand S.T.	43	413	456		500	500		1.2	1.1
Diatomite	Million S.T.	29	115	144	40	34	74	1.4	0.3	0.5
Feldspar	Million L.T.	38	94	132	500	324	824	(*)	3.4	6.2
Garnet	Thousand S.T.	911	456	1,367	700	1,540	2,240	0.8	3.4	1.6
Graphite	Million S.T.	2	23	25		10	10		0.4	0.4
Gypsum	Million S.T.	726	1,810	2,536	350	1,696	2,046	0.5	0.9	0.8
Kyanite	Million S.T.	9	18	27	15	13	28	1.7	0.7	1.0
Mica—scrap and flake	Million S.T.	7	3	10	250	1,150	1,400	(*)	(*)	(*)
Mica—sheet	Million lb	62	298	360		18	18		0.1	0.1
Perlite	Million S.T.	23	37	60	200	73	273	8.7	2.0	4.6

Pumice	Million S.T.	208	836	1,044	200	600	800	1.0	0.7	0.8
Sand and gravel	Billion S.T.	54	366	420	(A)	(A)	(A)	(*)	(*)	(*)
Stone—crushed	Billion S.T.	41	208	249	(A)	(A)	(A)	(*)	(*)	(*)
Stone—dimension	Million S.T.	79	2,800	2,879	(A)	(A)	(A)	(*)	(*)	(*)
Talc	Million S.T.	52	278	330	150	211	361	2.9	0.8	1.1
Vermiculite	Million S.T.	14	16	30	100	90	190	7.1	5.6	6.3
Anthracite	Million S.T.	124	4,583	4,707	550	4,150	4,700	4.4	0.9	1.0
Bituminous coal and lignite	Billion S.T.	21	89	110	(A)	(A)	(A)	(*)	(*)	(*)
Natural gas	Trillion c.f.	1,098	1,513	2,611	279	890	1,169	0.3	0.6	0.4
Peat	Million S.T.	43	10,328	10,371	(A)	(A)	(A)	(*)	(*)	(*)
Petroleum	Billion bbl	276	764	1,040	38	594	632	0.1	0.8	0.6
Shale oil	Billion bbl	15	5	20		50	50		(*)	2.5
Uranium	Thousand S.T.	1,240	1,540	2,780	130	220	350	0.1	0.1	0.1
Argon	Million S.T.	11	14	25	(A)	(A)	(A)	(*)	(*)	(*)
Helium	Billion c.f.	35	12	47	144	2	146	4.1	0.2	3.1
Hydrogen	Trillion c.f.	169	397	566	(A)	(A)	(A)	(*)	(*)	(*)
Oxygen	Million S.T.	962	1,764	2,726	(A)	(A)	(A)	(*)	(*)	(*)

A—Adequate
*Ratio of 10 or more
[1] Recoverable at U.S. 1971 prices.

Source: U.S. Department of the Interior, *Mining and Minerals Policy, 1973* (1973), Appendices, and unpublished data.

to meet cumulative world demand at least to the year 2000 and generally for many years more. This group includes many important items, such as aluminum, chlorine, chromium, iron, magnesium, nickel, platinum, coal, and oxygen. However, reserves are not presently adequate for 25 commodities including copper, lead, zinc, tin, natural gas, and petroleum. Past experience suggests that the possible shortage of such items will probably be forestalled by discoveries of more reserves, rising prices, development of new technology, recycling, and substitution of other commodities. World demands could, however, become much greater if developing countries were to increase their standard of living substantially; and this, of course, is a valid goal.

Generally, most resources will be adequate until the year 2000, especially if prices rise. As prices rise, demand will be curbed, and efforts to conserve, to recycle, and to use substitute materials will be increased. That prices will rise seems rather certain.

Much materials production depends heavily upon the use of energy for earth moving, mining, and transportation. Many products are made at high temperatures, requiring copious amounts of heat. Thus, the recent sharp rise in costs of all fuels will certainly increase the costs of making many minerals and materials available. Further, as new technologies are developed to exploit lower-grade ores, more energy is generally required to process the larger amounts of ores containing lower concentrations of desired minerals. It may also become necessary to introduce new operations which consume more energy and are otherwise more expensive to conduct.

Although a rise in prices will naturally curb demand, it is still a concern that there will ultimately be a limit to the practical availability of recoverable resources.

A qualitative appraisal of the sufficiency of world resources for selected mineral commodities developed by the U.S. Department of the Interior is given in Table 29. In this analysis it is presumed that the great bulk of future supplies will be drawn from the category of hypothetical resources rather than reserves.

U.S. Consumption and Imports of Minerals

In 1950, the United States consumed 2 billion tons of new minerals and materials, equivalent to 26,000 pounds per capita of population.[59] By 1972, as Figure 32 shows, about 4 billion tons (40,000 pounds per capita) were consumed. In 1972, the value of these domestic raw minerals and materials was $32 billion, imports accounted for another $4 billion, and reuse of old scrap an additional $2 billion, for a total of $38 billion. Processing increased the value to over $150 billion, to which must be added $10 billion for imports of processed products. For comparison, the GNP was $1,152 billion in 1972. Since exports of raw and processed minerals and materials totaled $8 bil-

Table 29

Selected Mineral Resources

Mineral commodity	Identified resources [1]	Hypothetical resources [2]
Aluminum	Very large	KDI
Antimony	Small	Small
Asbestos	Small	Insignificant
Barite	Very large	Very large
Beryllium	Very large	Huge
Boron	Very large	Huge
Bromine	Huge	Huge
Calcium chloride (brine)	Very large	Huge
Chlorine	Huge	Huge
Chromium	Insignificant	Insignificant
Clay	Large	Very large
Coal	Huge	Huge
Construction stone		
Crushed	Large	KDI
Dimension	Large	KDI
Copper	Large	Large
Diatomite	Huge	KDI
Feldspar	Huge	Huge
Fluorine	Small	Small
Gold	Large	KDI
Graphite	Very large	KDI
Gypsum	Huge	Huge
Iodine	Very large	Huge
Iron	Very large	Huge
Kyanite	Huge	Huge
Lead	Large	Moderate
Limestone and dolomite	Large	KDI
Lithium	Huge	Huge
Magnesium	Huge	Huge
Manganese	Large	KDI
Mercury	Small	KDI
Mica		
Sheet	Insignificant	Very large
Scrap and flake	Huge	Huge
Molybdenum	Huge	Huge
Natural gas	Moderate	Large
Nickel	Large	KDI
Nitrogen	Huge	Huge
Peat	Huge	KDI
Petroleum liquids	Large	Large
Phosphate	Very large	Huge
Platinum group	Moderate	Large
Potash	Very large	Huge
Rare earths	Huge	KDI
Salt	Huge	Huge
Sand and gravel	Large	KDI
Silver	Moderate	Large
Sodium carbonate and sulfate	Huge	Huge
Strontium	Huge	Huge
Sulfur	Huge	Huge
Talc	Very large	Huge
Thorium	Very large	KDI
Tin	Insignificant	Insignificant
Titanium	Very large	Very large
Tungsten	Moderate	Moderate
Uranium	Large	Large
Vanadium	Very large	KDI

See footnotes at end of table.

Table 29—Continued

Selected Mineral Resources—Continued

Mineral commodity	Identified resources [1]	Hypothetical resources [2]
Zeolites	Huge	Huge
Zinc	Very large	Very large
Zirconium	Large	KDI

Huge—Domestic resources (of the category shown) are greater than ten times the minimum anticipated cumulative demand (MACD) between 1968 and 2000.
Very large—Domestic resources are two to ten times the MACD.
Large—Domestic resources are approximately 75 percent to twice the MACD.
Moderate—Domestic resources are approximately 35 to 75 percent of the MACD.
Small—Domestic resources are approximately 10 to 35 percent of the MACD.
Insignificant—Domestic resources are less than 10 percent of the MACD.
KDI—(Known data insufficient)—Resources not estimated because of insufficient geologic knowledge of surface or subsurface areas.
[1] Includes reserves and materials other than reserves which are reasonably well known as to location, extent, and grade and which may be exploitable in the future under more favorable economic conditions or with improvements in technology.
[2] Undiscovered but geologically predictable deposits of materials similar to identified resources.

Source: U.S. Department of the Interior, *Mining and Minerals Policy, 1973* (1973), p. 54.

lion, there was a deficit of $6 billion ($8 billion minus $4 billion for raw materials imports and another $10 billion for processed product imports) in the balance of trade. Obviously, domestic resources have not kept pace with domestic demands. Moreover, this imbalance has been made greater by the rise in price of imported petroleum.

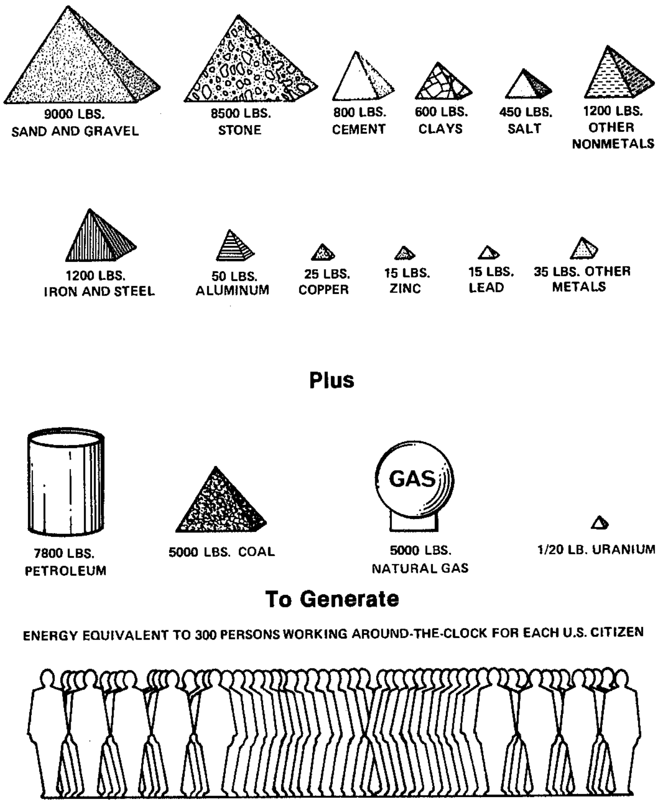
Of the nearly 40,000 pounds of minerals and materials consumed per capita in the United States in 1972 (see Figure 32) about 46 percent by weight was fuels, about 51 percent was nonmineral—mostly sand, gravel, cement, and stone used in construction—and about 3 percent was processed minerals.

The United States is one of the more resource-rich nations in the world. However, as shown in Table 28, the United States does not have sufficient reserves of 47 of the 87 commodities listed to satisfy cumulative demands to the year 2000. And it is self-sufficient in only 2 of the 25 commodities for which world demand exceeds reserves. In fact, the United States now imports from 90 to 100 percent of its needs in 8 important materials, including the platinum group, chromium, aluminum, and manganese; from 50 to 90 percent in another 12 materials, including titanium, tin, asbestos, nickel, zinc and mercury; and 15 to 50 percent of its needs in 14 more materials, including gypsum, petroleum, iron, lead, and copper. This is depicted in Figure 33.

Exploitation of reserves is dependent upon many other factors besides their known presence at various locations in the earth's crust. Exploiting reserves is capital-intensive and heavily dependent on fuels

Figure 32

U.S. Annual Requirements for New Materials per Capita, 1972



U.S. Total Use of New Mineral Supplies in 1972 Exceeded 4 Billion tons

Source: U.S. Department of the Interior, *Mining and Minerals Policy, 1973* (1973), p. 18.

of a quality which will not seriously degrade either the product or the environment. Recovery of the materials from the earth and subsequent processing operations must compete with other possible uses for the land necessary to do such work. International trade considerations may arise which create an imbalance of payments. Time required to develop alternate fuels and substitute materials may be significant. Altogether, the combined effect of these constraints may

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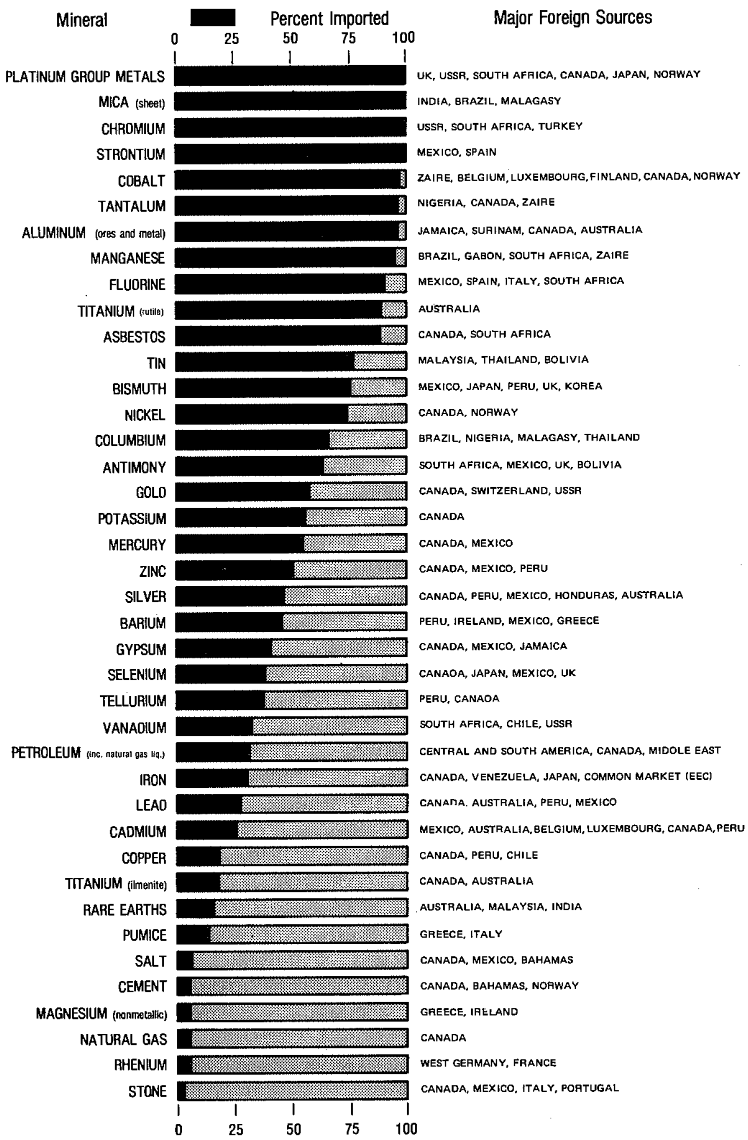
Figure 33

U.S. Demand for Minerals and Mineral Resources Supplied by Imports, 1972

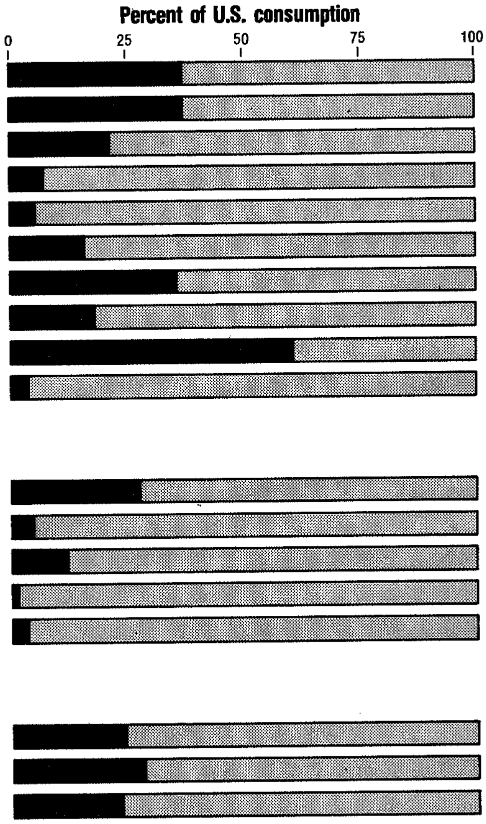


Source: U.S. Department of the Interior, *Mining and Minerals Policy, 1973* (1973), p. 22.

Figure 34

Metals Recovered from Scrap in the United States[1]

Major	Short tons recycled from scrap
	46,400,000[2]
Lead	506,000
Copper	473,000
Aluminum	250,000
Zinc	81,000
Chromium	60,000
Nickel	73,900
Tin	13,000
Antimony	17,600
Magnesium	2,700
Minor	
Mercury	494
Tungsten	250
Tantalum	62
Cobalt	65
Selenium	15
Precious	
Silver	1,049
Gold	82
Platinum group	10



[1]Excluding home scrap.
[2]Including exports.
Source: U.S. Department of the Interior, *Mining and Minerals Policy, 1973* (1973), p.20.

cause the equivalent of a materials shortage which will be every bit as real to the consumer as if reserves were actually exhausted.

All countries depend heavily on imports of numerous materials, for useful concentrations of resources are not spread uniformly among nations but are instead located in an unbalanced and scattered fashion. Therefore it is a global fact of life that, so far as resources are concerned, there is an interdependence among nations that transcends national boundaries, economic and technical capabilities, or political ideologies.

Recycling

U.S. recovery of minerals and materials through recycling is depicted by Figure 34. The total recovered annually is about 48 million tons, about 1 percent of consumption or 458 pounds per capita. Almost all of this recovery—440 pounds per capita—is iron; about half of that comes from iron foundry and steel mill scrap, whereas the other half is purchased. Obviously, there can be no recovery of fuels that were burned, and little can be salvaged from construction materials, except for used brick. There is, however, great potential for increasing the amount of processed mineral products recovered for recycling.

The importance of recycling is two-fold: it augments supply, thereby preserving the resource; and it conserves the energy otherwise required to process virgin materials. Potential energy savings are considerable. To process aluminum from virgin sources requires 30 times more energy than processing aluminum from recycled scrap. Steel made from virgin ores requires two and a half times more energy than steel made from recycled metal. That is, to process 1 million tons of steel from ore requires the energy equivalent of 2.5 million barrels of oil, while processing the same amount through recycling requires 1.0 million barrels. Thus every million tons of steel scrap that is lost to reconversion by corrosion or by burial in a dump also represents the loss in energy equivalent to 1.5 million barrels of oil.

As discussed in Chapter 2, the recent increases in energy prices are serving as a major stimulant to recycling by creating new markets for recycled materials. Hence, we can expect that the proportion of minerals and materials recovered through recycling in the future will increase considerably beyond that shown by Figure 34.

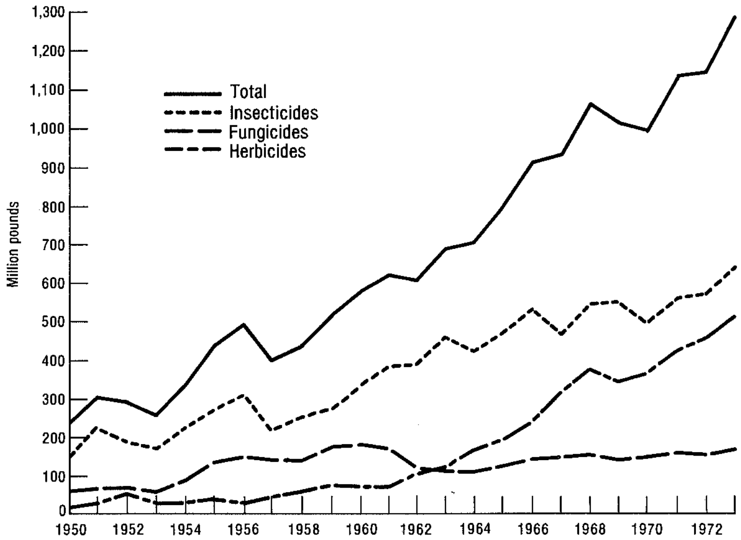
Pesticides

Over a billion pounds of pesticides—insecticides, herbicides, and fungicides—are manufactured in the United States each year, of which more than three-quarters is used domestically. The amount manufactured and used continues to grow, with herbicides showing the most rapid rate of growth in the last decade (Figure 35).

Environmental problems related to pesticides are usually very difficult to assess. Analysis and understanding of potential problems are greatly aided through the use of "chemical flow" analysis, particularly commercial flow analysis (the route of chemicals from raw materials through manufacture to end use) and environmental transport analysis (the route and rate by which the pesticide flows into and through the environment). Flow analysis provides an essential tech-

Figure 35

Synthetic Organic Insecticide, Herbicide, and Fungicide Production, United States, 1950-73



[1]The Stanford Research Institute method eliminates double counting of phenoxy acids, and thus the figures are lower than official Tariff Commission totals for 1950-70.

Sources: 1950-70 from Stanford Research Institute, "Environmental Indicators for Pesticides," prepared for the Council on Environmental Quality, April 1972; 1971-73 from U.S. Tariff Commission (preliminary data).

nique for locating the points at which pesticides enter the environment, thereby providing an essential starting point for evaluating the environmental effects of the present use of a pesticide and comparing it with alternatives.

Through a contract with the Midwest Research Institute (MRI), CEQ and EPA this year undertook such an analysis of pesticide flows. This study analyzed available information and data on the production, import, and export of raw pesticides, and examined their use by agriculture, by the industrial-commercial-institutional sector, and by agencies of Federal, state, and local governments—a crude commercial flow analysis. In addition, detailed case studies were made of the production, distribution, and use patterns of 25 representative pesticides which constitute more than 80 percent of the total value of annual use—the first stage of an environmental transport analysis.[60]

Commercial Flows

According to the U.S. Department of Agriculture, farmers in 1971 used approximately 494 million pounds of pesticides, or 59 percent

of U.S. total production. This amount is 40 percent above 1966 levels.[61] Table 30 gives the USDA estimates of the percentages of pesticides used by farmers in the United States in 1966 and 1971.

Farmers' use of pesticides is highly concentrated, with only a small number of crops accounting for 80 to 90 percent of all agricultural uses. For example, three crops account for close to 80 percent of herbicides used on farms—corn (about 50 percent), soybeans (17 percent), and cotton (11 percent). Only two crops account for nearly 70 percent of agricultural insecticide use—cotton (about 50 percent) and corn (18 percent). Nearly 60 percent of all agricultural fungicides is used on fruit and nut crops, and 25 percent is applied on vegetables.

The larger and more diverse industrial, commercial, and institutional sectors consume approximately 23 percent of domestically used pesticides to control highly varied pest problems. Table 31 shows MRI estimates for the use by these sectors of the 25 pesticides studied. The 9 pesticides whose use is estimated at 4 million pounds or more reflect the diverse nature of pest problems in this sector. Chlordane is used within structures to control structural pests such as termites and nuisance pests like cockroaches. Malathion is also used for indoor nuisance pest control but is used in larger quantities to prevent insect damage in stored foods. The herbicides 2,4-D and MSMA are used for brush control, particularly in forest management, along utility lines and railroad rights of way, and in controlling aquatic weeds in waterways. Sodium chlorate is used as a general weed-controlling agent throughout industry but has found particular use in "sterilizing" railroad beds. Nearly a billion pounds of creosote is used annually and close to 48 million pounds of pentachlorophenol, both

Table 30

Estimated Use of Pesticides by U.S. Farmers, 1966 and 1971

[In million pounds, active ingredient]

Type of Pesticide [1]	Total U.S. use			Farm use			Farmers' share of total (percent)	
	1966	1971	Percent increase 1966–71	1966	1971	Percent increase 1966–71	1966	1971
Herbicides	227	359	58	125	251	101	55	70
Insecticides	329	319	−3	195	201	3	59	63
Fungicides	125	155	24	33	42	27	26	27
Total	681	833	22	353	494	40	52	59

[1] Herbicides include plant growth regulators, defoliants, desiccants; insecticides include miticides, rodenticides, fumigants. Excluded are sulfur, creosote, petroleum oils, and several other pesticides.

Sources: U.S. Department of Agriculture, *Quantities of Pesticides Used by Farmers in 1966*, Agricultural Economic Report No. 179 (1970); and U.S. Department of Agriculture, Economic Research Service, *Quantities of Pesticides Used by Farmers in 1971* (1974).

Table 31

Pesticide Use in the Industrial, Commercial, and Institutional Sectors

[In million pounds, active ingredient]

Pesticide	Total
Insecticides	
Aldrin	1.7
Carbaryl	1.0
Chlordane	6.5
Diazinon	1.2
Malathion	4.0
Toxaphene	1.0
Herbicides	
Atrazine	1 7
Bromacil	2.3
2,4-D	6.0
Diuron	3.8
MSMA	4.0
Sodium chlorate	19.0
Fungicides and wood preservatives	
Creosote	970.0
Pentachlorophenol and sodium salt	47.5
Fumigants	
Methyl bromide	16.4
p-Dichlorobenzene	14.0

Source: Midwest Research Institute, "Production, Distribution, Use, and Environmental Impact Potential of Selected Pesticides," prepared for the Council on Environmental Quality (April 1974).

used as wood preservatives. Methyl bromide is used to fumigate stored foods and p-dichlorobenzene within structures to control moths.

Governmental agencies use approximately 2 percent of all pesticides. With the exception of wood preservatives, which agencies seldom use, governmental use of classes of pesticides closely parallels nationwide patterns.

Environmental Flows

Commercial flow analyses indicate the nature of chemical use. This information permits estimates to be made as to the chemical form and quantity likely to enter the environment. It also provides a means of determining where the substance enters the environment. When supplemented with information on environmental transport and ecological and health effects, such analysis facilitates assessment of the environmental problems from a given chemical.

Data for this first stage was collected by MRI for 25 selected pesticide case studies. For each of these chemicals, MRI assembled information on product description; manufacturers and locations; production methods and waste control technology; formulation; packaging, and distribution; use patterns; alternatives; and environmental

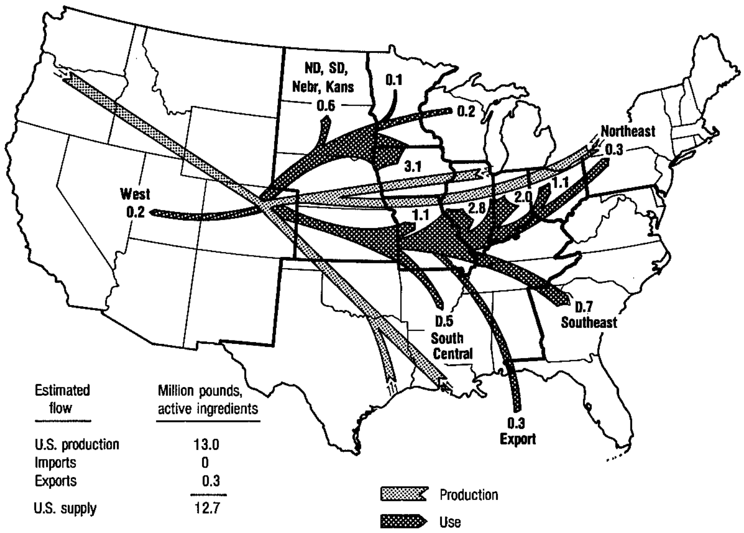
impact. Material flow diagrams showing the movement of raw materials to manufacturing locations and the flow of pesticides into the environment through manufacturing losses and use were generated for each.

Figures 36 and 37 represent two of the many different types of pesticide material flow patterns observed in the case studies. In the case of aldrin (Figure 36) raw materials flow from Oregon, Texas, Illinois, and New York to a single manufacturing location in Colorado. Approximately 11 million of the 12.7 million pounds of aldrin consumed annually are used in the Midwest, particularly in Iowa, Missouri, Illinois, Indiana, and Ohio. By contrast (Figure 37), sodium chlorate is produced in at least 11 different locations and used throughout the Nation.

Because pesticides are introduced intentionally into the environment, an index of environmental quality relating to them cannot be measured in terms of the quantity of pesticides produced. Rather, the most important measures are the environmental concentrations of pesticides accumulated and their effects. To make such a determination, however, requires research and monitoring. Thus, flow analyses similar to those done by MRI provide information on the quantity and location of chemicals entering the environment and thereby establish the basis for a very valuable assessment tool.

Figure 36

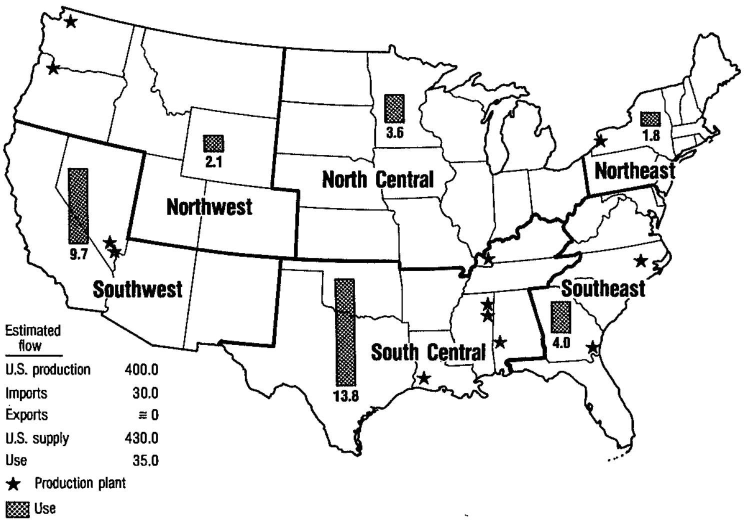
Aldrin Flow Diagram, 1972



Source: Midwest Research Institute,"Production, Distribution, Use and Environmental Impact Potential of Selected Pesticides,"(Chicago, 1974), p.128.

Figure 37

Flow Diagram, Sodium Chlorate, 1972



Source: Midwest Research Institute, "Production, Distribution, Use and Environmental Impact Potential of Selected Pesticides", prepared for the Council on Environmental Quality, (Chicago, 1974), p. 253.

Wildlife and Habitat

Our Nation has more available information about wildlife and wildlife habitat resources than any other country. However, this information is almost entirely the result of studies and monitoring conducted with very limited scope and intent, such as censuses of species that have important commercial or sport value, monitoring of pests, and studies of individual ecosystems. Available data are usually limited to species and localities of special interest to man. Our abilities to characterize most species, wildlife communities, and habitat trends are incomplete and relatively primitive.[62]

Compelling reasons for improving our wildlife monitoring capabilities are easily identified. As the following discussions indicate, these reasons include the considerable economic and public use value of the Nation's wildlife resources; the importance of preserving endangered species; and the value of wildlife monitoring as potentially indicative of environmental conditions and disturbances.

Economic and Public Use Values

Nearly 42 million Americans purchased hunting or fishing licenses in 1973.[63] State revenues from these licenses exceeded $242 million.

Nearly 9 million fishing licenses were purchased in California, Michigan, and Texas alone. State hunting license sales exceeded a million each in the states of California, Michigan, New York, Pennsylvania, and Texas. Moreover, the public demand in some areas presently exceeds the licenses which can be issued. In Idaho, applications for big game hunting permits in 1973 exceeded available permits by more than five to one. In Minnesota, 1973 moose hunting applications exceeded the number of permits that could be issued by more than ten to one.

In addition to state license revenues, sport hunting and fishing generate considerable incidentally related revenues. Total estimated expenditures of big game hunters on National Forest lands alone, for example, exceed $2.5 billion per year.[64] In 1972, more than 9 million big game hunters visited these lands. An additional 4 million visits by small game hunters were recorded the same year.

Nonconsumptive uses of wildlife and habitat resources also have achieved considerable importance, especially in recent years. For 1970, the U.S. Department of the Interior's National Survey of Fishing and Hunting identified more than 12 million persons engaged in wildlife observation and photography, as compared with 21 million hunters. In 1971, nature observers and photographers accounted for nearly 18 million visitor days in National Forests.[65] On the basis of surveys conducted in the southeastern United States, estimated user-values to persons engaged in wildlife observation and photography averaged $65 to $80 per day, as compared with $39 to $60 per day for hunters. The value of wildlife and habitat resources in the Southeast has been economically assessed at $12.3 billion for nonconsumptive uses, as compared with $11.8 billion for consumptive uses.[66]

Economic factors and estimated values to users are by no means the only, or even the most important, basis upon which to demonstrate the need for improved study and monitoring of our Nation's wildlife and habitat resources. It is obvious, however, that effective and efficient use, management, and protection of these resources depend upon an adequate information base.

Endangered Species

Information about wildlife species threatened with extinction provides a case example of the need for improvement in our understanding. Our ability to recognize an endangered species has always depended as much on the status of our knowledge about that species as upon its actual endangered status.

During the past three centuries, approximately 300 species worldwide are estimated to have become extinct. At least 50 of these known species were higher vertebrate animals native to the United States and its territories. Nearly all of these extinctions are directly or indirectly attributable to human influences. But the modern species

The whooping crane,
a threatened species.
Only about 100 exist today.

extinctions of which we are aware represent only a portion of those which have occurred, since our interest and limited study have been focused mostly on the more obvious higher animals. Information about the endangered status and extinctions of lower animals, particularly invertebrates, has been generally lacking.

The Federal Government has been formally involved in protecting threatened species since 1966. The U.S. Fish and Wildlife Service has recognized for some time that approximately one-tenth (nearly 200 species) of the higher animals (mammals, birds, reptiles, amphibians, and fishes) in the United States are endangered. During the past 2 years, however, the Office of Endangered Species of the U.S. Department of the Interior has been reviewing information pertinent to the endangered status of not only these higher animal groups, but also of three of the classes of lower animals: crustaceans, clams, and snails.

The review has indicated that approximately one-tenth (100 species) of the clams and one-tenth (200 species) of the snail species in the United States also appear to be threatened.[67] Moreover, other studies have found that approximately one-tenth of our North American plant species are also presently endangered.

The concept that one-tenth of the biological diversity in major groups may be threatened is significant. Although about 80 percent of the animals known to be threatened are geographically isolated to some degree, the other 20 percent are widely distributed.[68] Man depends directly on thousands of species of living organisms for his needs, and indirectly on the adaptive diversity and ecological roles played by countless others. Although the apparent importance of some of these species to man may be aesthetic or of human interest, it is well known, albeit frequently not well understood, that each kind of living organism occupies a particular role or niche in the

environment, and that the survival of sufficient numbers of individuals of any species may be important to the dynamic functioning of the ecosystems in which they occur.

The extinction of living species is not a human innovation. Extinction and replacement by other living forms has been a fundamental natural aspect of the evolutionary process as long as life has existed on earth. In modern times, however, human activities have greatly accelerated the rate of species extinctions. Perhaps of equal importance, man's activities have altered the fundamental nature of this process.[69]

Throughout biological evolution, most "extinctions" appear to have been stages in the process of adapting genetic lineages to changing environmental conditions. Although some catastrophic extinctions did occur naturally, producing total loss of a genetic line, such catastrophes were comparatively rare. In modern times, however, man-induced extinctions—whether due to habitat loss or alteration, pollution, insufficiently regulated hunting, or other factors—have mostly amounted to total genetic losses.

It is not difficult to gain general agreement that man-caused increases in the endangerment and extinction of wildlife are undesirable. However, it is more difficult to obtain such a consensus when consideration must be given to the economic costs involved in correcting such trends, including natural habitat preservation, pollution control, regulation of pesticides and other toxic substances, and wildlife and park management. Endangered species often are, in effect, competitors for habitat and other resources with other kinds of human uses and needs.

Measures needed to protect endangered species vary considerably in difficulty and cost. Of the approximately 400 invertebrate species which presently appear to be threatened, for example, about one-third probably could be restored by relatively inexpensive means. Such measures might include modifying the boundaries of designated natural areas such as Mammoth Cave National Park or the proposed Channel Islands National Monument; acquiring and protecting a number of caves or other small areas, each of which contains one or more endangered invertebrate species; and additional management of parks and refuges.

Another one-third of the endangered lower animal species are threatened principally by water pollution. Approximately 60 species of clams could possibly be restored and protected by improved water pollution control efforts in five southern rivers: the Duck, Powell, and Clinch Rivers in Virginia and Tennessee; the Green River in Kentucky; and the Altamaha River in Georgia.

The remaining one-third of these 400 endangered shellfish species, however, would be considerably more difficult to protect. These are threatened by complex factors, such as over-collecting, channelization, highway and housing development, dams, introduced species

such as the Asian snail, dredging, quarry washing, poor erosion control, and lowering of water tables.

As stated earlier, the identification of threatened species and other significant wildlife trends must precede any corrective measures, and our knowledge base for making such identifications is deficient in many respects. Even with the additional species identified in the recent endangered status review, our present lists of threatened species and subspecies are known to be incomplete. Generally, these lists reflect geographical areas in which the most scientific work has been done, or which contain habitats of species that have important commercial or sport harvest value.

Monitoring

Wildlife and wildlife habitat monitoring has not received the same priority as the monitoring of air and water quality. Although the realized and potential economic benefits of commercial and recreational uses of our Nation's wildlife and habitat resources are great, the esthetic and scientific benefits are neither well understood nor readily quantifiable. Furthermore, wildlife monitoring is often difficult. Many populations are widely dispersed, highly mobile, accessible only with great difficulty, and/or fluctuate greatly from year to year. Others are geographically restricted in their distribution and often are considered to be primarily of local interest.

The potential benefits of improved and better-coordinated wildlife monitoring seem considerable. In addition to providing information about important species to guide management and corrective efforts, improved monitoring could increase our ability to utilize wildlife as a continuous early-warning system for environmental conditions and disturbances. Any rapid, major change in a species population, for example, should constitute a warning to investigate the cause. Moreover, improved monitoring of managed populations would increase our abilities to assess the effectiveness of such management.

CEQ's 1972 Annual Report discussed preliminary recommendations of the Smithsonian Institution [70] for improving our capabilities in wildlife monitoring on a nationwide basis. In addition to recommendations related to improved assessment of wildlife and habitat trends, this report suggested monitoring a number of species (see Table 32) preliminarily proposed as indicators of various aspects of environmental quality.

Any utilization of wildlife population trends as environmental quality indicators would require caution. The reason for a dramatic change in a population of any species could not be confidently predicted in advance. Rather, such a change would signal a need for closer investigation of its causes.

Managed, regulated, and harvested wildlife populations obviously respond to direct human influence as much as to their natural en-

Table 32

Possible Species Indicators of Environmental Quality

Chemical contamination
- Aquatic
  - Bald eagle, osprey, herring gull, trout, shrimp
- Terrestrial
  - Golden eagle, robin, mourning dove, woodcock, cave bat
- Atmospheric
  - Lichens, mosses, selected crop and forest plant species

Garbage and filth contamination
- Herring gull, starling, domestic pigeon, Norway rat

Crop damage
- Starling, red-winged blackbird, cowbird, common grackle, Norway rat

Urban degradation
- Starling, domestic pigeon, Norway rat

Esthetic quality
- Condor, golden eagle, bald eagle, robin, bluebird, cardinal, mockingbird, polar bear, prong-horned antelope, sea otter, beaver, alligator.

Wildlife recreation
- Mallard, redhead, canvasback, Canada goose, mourning dove, woodcock, prong-horned antelope, sunfish, bass, catfish, trout, pickerel

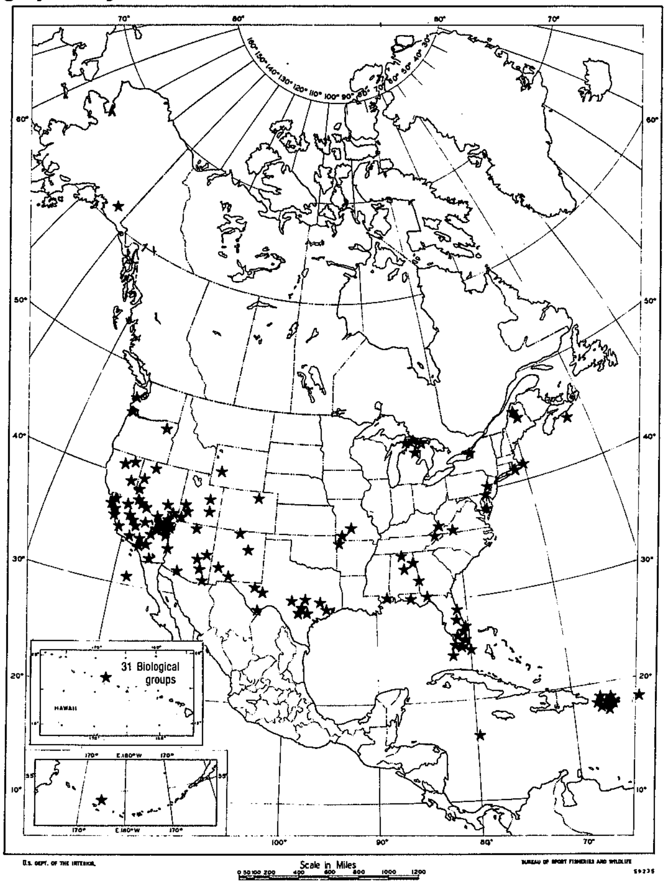
Source: D. W. Jenkins et al., "Development of a Continuing Program to Provide Indicators and Indices of Wildlife and Natural Environment," Smithsonian Institution Ecology Program, Final Report to the Council on Environmental Quality, 1972.

vironment, so in many cases, their selection as general environmental indicator species would not be appropriate. Many endangered species also are of limited value as indicators for general use, since most are geographically restricted. Moreover, the natural habitats of these isolated species are often not typical of the biomes in which they are located, and a single man-produced or natural threat may be capable of causing their extinction. In addition, the great majority of the geographically isolated endangered species occur only in the southern and western parts of the country (Figure 38).

On the other hand, a number of species of birds, widely distributed endangered species, and other forms of wildlife seem to have potential as environmental indicators. Moreover, some capability for nationwide trend monitoring is presently available for some of these species. For example, non-endangered, non-game bird populations have been monitored annually by the National Audubon Society and the continental Breeding Bird Survey of the U.S. Fish and Wildlife Service.[71] With the collaboration of the Canadian Wildlife Service and the help of approximately 2,000 observers, this survey has been conducted since 1966. The survey employs data from a network of randomly distributed roadside bird counts conducted throughout the United States and Canada each year during breeding season. Nearly 500 bird species are observed each year by this network. Data on approximately 120 of the most abundant species are statistically examined by computer to monitor state, regional, and continental population trends. For most of the bird species, observed population

Figure 38

Distribution of Endangered Species That Are Geographically Isolated



Source: Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, "Final Environmental Statement for the Proposed Endangered Species Conservation Act of 1973," August 7, 1973.

changes have been small during the past several years, averaging less than 2 percent per year. There are notable exceptions, however.

From 1968 to 1972, starlings increased at an alarming rate, especially from the Rocky Mountains westward. In spite of local control measures, the average annual starling increase observed in western states has been approximately 25 percent. In this regard, it is noteworthy that starlings have been identified as an important indicator species for garbage and filth contamination, crop damage, and urban degradation.[72]

A number of species of birds have potential as indicators of environmental quality.

In the eastern states, the greatest population increases have occurred in two introduced (non-native) species. The house finch, a western bird introduced in New York in the 1940's, has been increasing by about 18 percent per year since 1966. The cattle egret, an invader from South America, has increased by about 13 percent per year. Other species for which significant increases of 4 to 7 percent per year have been observed include the barn swallow, house wren, robin, and common grackle.

Major population declines observed by the Breeding Bird Survey have included the lark bunting and the yellow warbler, which have decreased approximately 11 percent and 15 percent per year, respectively, in the central United States. After formerly declining, the eastern bluebird recovered substantially in 1969–72.

Breeding Bird Survey data for 1972–73 show that Hurricane Agnes and the severe midwest winter of that year caused significant reductions in local populations of some bird species. Good production outside of affected areas, however, appears to have compensated for these losses. Consequently, most reductions were not significant on a nationwide basis.

Besides the Breeding Bird Surveys, consideration is being given to other ways to conduct efficient, coordinated, comprehensive wildlife monitoring. One possibility is increased use of remote sensing.[73] Many valuable potential benefits of aerospace technology might be utilized to a greater extent for these purposes. However, most remote sensing capabilities are better related to characterizing various aspects of our wildlife resources, such as migration patterns and physiological functioning, rather than providing inventories of wildlife populations. Nevertheless, the capabilities of multispectral scanning both to characterize and to inventory natural habitat are developing rapidly.

In summary, the need for improved wildlife monitoring is apparent, and CEQ is working with Federal agencies, universities, and professional societies in various disciplines to define a proper Federal

role in coordinating and supplementing present wildlife monitoring and related ecological research. A forthcoming report of a Committee on Ecological Research sponsored by CEQ and the Federal Council on Science and Technology will state:

> Ecological research activities are scattered throughout many agencies of the Federal Government with little overall coordination, direction, or definition of priorities. Large volumes of survey, monitoring, and research information of ecological value are gathered by Federal agencies, but with limited or specialized use, generally primarily by the collecting agency. These data, together with non-Federal information, constitute resources of enormous value if selected, focused, analyzed, and integrated for applicability to specific environmental problems, to strengthening the ecological basis for regulatory actions in land, water, air, and resource management, and to mitigation of environmental impacts. Without a Federal focus, response to problems which require ecological information or capability will continue to be fragmented, costly, redundant, and reflexive rather than strategic, efficient, and contributory to national goals and productivity.

Environmental Indices and Interpretive Techniques

The Need for Better Interpretive Techniques

As stated in the introduction to this chapter, there is a critical need for accurate and timely information about environmental conditions and trends, in order that important decisions affecting environmental quality and natural resources can be made on the most informed basis possible. The key word here is information, not just data. Although many programs for acquiring environmental data are important and valuable, the interpretation of their results usually requires technical training and experience. The general public and many decisionmakers in government and industry meanwhile must be supplied with comprehensive assessments of the significance of these data on a timely basis, thereby enabling these individuals to appreciate the feasible options and the consequences of alternative decisions.

Having recognized this need, the Congress authorized and directed, in the National Environmental Policy Act of 1969, that to the fullest extent possible, all agencies of the Federal Government shall ". . . identify and develop methods and procedures, in consultation with the Council on Environmental Quality . . . which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations." [74]

In CEQ's previous Annual Reports and other studies, attempts

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have been made to (1) develop and provide these kinds of interpretive analyses and (2) report on progress in developing environmental indices and indicators as potential practical tools by which environmental assessments could be effectively communicated to the public. Other Federal agencies also have contributed to this effort. In general, however, the response of both the Federal Government and the scientific community to this important need and mandate has been inadequate. Both the National Academy of Sciences and the Library of Congress have recently concluded [75] that environmental indices and other interpretive tools are feasible and much needed; that previous efforts have been inadequate; and that an intensified Federal effort is needed in this area.

Developing Indices and Other Techniques

It should be recognized that considerable difficulties are involved in the development of any environmental index or interpretive technique. There are no measurable parameters called "environmental quality," "air quality," "water quality," or "ecological balance" any more than there is a measurable medical parameter called "health." Since we cannot directly measure environmental quality, we monitor various individual parameters—such as particulate matter concentrations in air or dissolved oxygen levels in water—which are in some way related to it. To form reasonable judgments about environmental conditions and trends, we must conduct monitoring programs that experimentally ask needed questions; we must obtain and analyze data that are valid, accurate, and representative; and we must make a number of scientific and socioeconomic decisions about how to weigh these data in forming interpretations and judgments. Generally, if we seek to obtain high accuracy and representativeness in our interpretive techniques, they can become quite complicated and may be fully understood only by technically trained people. On the other hand, if we seek simplicity in communicating our assessments of environmental quality, we run increased risks of misrepresenting reality. The most accurate and confident assessments of environmental quality will always require special studies by competent professionals for each question asked.

During the past few years, the type of simplified interpretive technique that has received the most attention in these regards—and in the Council's Annual Reports—has been the aggregated numerical index. Whether designed to represent air quality, water quality, or some other environmental aspect, such a numerical index typically consists of an equation that can combine and transform data on one or more individual parameters into a single aggregated value. In many indices, the transformation processes introduce a numerical relationship of the measured data values to established standards or reference levels for each parameter. Some indices are also designed to facilitate differential weighting of the various parameters, so that

estimates of the relative significance of each parameter, based on ecological or health effects, become a factor in arriving at a final index value.

In attempting to develop and use various environmental indices, one encounters serious problems. These include a lack of consensus on index design and weighting of factors; serious concerns about losing sight of the limitations and shortcomings normally present in any data, once they are "hidden" in an index; and the losses of information that result from the mathematics of index calculation. In other words, even though it may be generally acknowledged that the average citizen derives little information from learning, for example, that ambient sulfur dioxide in a city averaged 48 micrograms per cubic meter of air over a day or a year, considerable doubts are also frequently expressed about either the validity or usefulness of characterizing the city's air quality as having an overall index value, for instance, of 35. This criticism can apply even to the best-designed indices currently available, as well as the many indices of limited scientific validity that have proliferated in recent years among many local governments and news media.

The presently unsatisfactory state of our development of environmental indices and other interpretive techniques has therefore been due both to the difficulties of the problem and to a cautious attitude of the Federal Government and the scientific community. It is important to recognize, however, that questions about the validity or usefulness of any particular aggregated numerical index are different from more fundamental questions about the needs for improved interpretive techniques. Failure to recognize this distinction can raise impediments to critically needed efforts toward better public information.

There are many potentially useful types of indices, indicators, and other techniques. The aggregated numerical index does have potential value, but it is only one of the types of techniques that can be utilized. The range of other techniques can include, for example, a simple graphic representation of the geographic distribution of air emissions or water discharges in a region over time, by parameter; expressions of the frequency of ambient standards violations; or the dynamics of a "biological indicator" species population. The basic criteria by which the value of such techniques should be assessed are relatively straightforward. They should facilitate improved communication of environmental quality information to the public. They should be readily derived from available monitoring data, or at least from data feasibly obtainable on a timely basis. They should strike a balance between oversimplification and complex technical conceptualizations. They should impart an understanding of the significance of the data they represent. They should be objectively derived but amenable to comparison with expert judgments, in order that their validity can be assessed. In addition, they should be designed so that in an aggregate presentation, they form a complementary set of in-

terpretive techniques that help the public reach informed decisions about environmental quality and management needs.

Recent Progress

Some progress has been made during the past year. Regarding air quality indices, the status of which has been described in detail by CEQ in previous Annual Reports, most of the relatively advanced techniques have been reviewed by EPA,[76] and Oak Ridge National Laboratory,[77] as well as by the Library of Congress [78] and the National Academy of Sciences.[79] EPA is also conducting a survey and evaluation of the many air quality indices presently in use. For water quality, EPA is evaluating a number of indices and other simplified water quality reporting and interpretive techniques. Of the indices being studied by EPA, the National Sanitation Foundation's water quality index, described in CEQ's 1973 Annual Report, is limited because of its focus on parameters related primarily to treatment plant design, as well as the difficulty of relating its values to water quality standards or stream flow effects. The Pollution Profile, also being evaluated by EPA, combines two indices: a Water Quality Index and a Pollution Index. The Pollution Profile relates to water quality standards but also involves many subjective determinations. EPA is also evaluating an Objective Water Quality Index, which employs a nonsubjective, computational approach to relating water quality data to standards. Individual index factors can be weighted in this index on the basis of significance criteria. Another indicator under consideration relates the frequency of violations of standards or reference levels for several pollutant categories. Finally, EPA is also evaluating a technique being developed for combining indices of biological diversity and redundancy in aquatic ecosystems as a potentially useful supplement to indices related to water quality standards.

The Task Before Us

CEQ will continue its efforts in the development of interpretive techniques related to air quality, water quality, land use, and ecological conditions and trends. However, no Federal committee or small staff agency can adequately accomplish this task without considerable help from the scientific community and support from the agencies that are primarily responsible for acquiring or assimilating environmental data. To achieve the capabilities needed, it will apparently be necessary to increase the responsibilities of the Environmental Protection Agency; the Departments of the Interior, Agriculture, Commerce, Defense, and Health, Education, and Welfare; the Atomic Energy Commission; and the National Science Foundation. These responsibilities would involve the task of developing meaningful indices, indicators, and other techniques for interpreting environmental monitoring data, as well as periodically reporting data in such formats. Failure to meet these needs will result not only in less in-

formed decisions about environmental quality, but also in some misdirection of resources expended on environmental monitoring and data processing.

Environmental Data

In the past, a number of readers have suggested that the Annual Report would be more useful if it included additional basic statistical information pertaining to environmental quality. This section is an initial attempt to meet that need. Readers are invited to provide suggestions for improving these data tables so that this section can become a brief "Environmental Statistical Abstract."

The following tables are provided in this initial presentation:

33. World Trends in Population and Vital Statistics, by Geographical Region and Development Status
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Table 33

World Trends in Population and Vital Statistics, by Geographical Region and Development Status, 1950–72

Topic	World total	Development status [1]		Geographical region						
		More developed	Less developed	Africa	Northern America	Latin America	Asia	Europe	Oceania	Soviet Union
Population (millions)										
1950	2,486	852	1,634	217	166	162	1,355	392	13	180
1960	2,982	970	2,012	270	199	213	1,645	425	16	214
1970	3,632	1,078	2,554	344	228	283	2,056	462	19	243
1972 [2]	3,780	1,102	2,678	363	231	300	2,149	469	20	248
Average annual increase, 1950–72 (percent) [3]	23.6	1.31	2.90	3.04	1.77	3.86	2.68	0.90	2.45	1.72
Average annual rates per 1,000 population, 1965–71										
Births	34	19	41	47	19	38	[4] (29)(43)	18	25	18
Deaths	14	9	16	21	9	10	[4] (12)(15)	10	10	8
Natural Increase	20	10	25	26	10	28	[4] (17)(28)	8	15	10
Life expectancy at birth, 1965–70 [5]	53.1	70.4	49.6	43.3	70.5	60.2	(52.2)(48.8)	70.9	64.8	70.3

[1] Development status is based on level of economic development. The United Nations recognizes two categories, less developed and more developed (Generally, less developed countries have high fertility and the more developed countries have low fertility.)

[2] Population Council estimate based on the 1971 population for each region and on the rates of natural increase shown.

[3] Births minus deaths.

[4] Figures are for East Asia and balance of Asia.

[5] Life expectancy at birth is defined by the United Nations as "the average number of years of life to which a group of newborn infants could look forward if they were subjected to risks of death at each age according to the mortality rates observed at each level of age, in the area and during the period to which the measure refers."

NA=not available.

Sources: UN, *Demographic Yearbook, 1971*, 23rd issue (New York: UN Department of Economic and Social Affairs, 1972); UN Population Division, Working paper No. 37, December 17, 1970 (mimeo).

Table 34

Trends in U.S. Population and Vital Statistics, 1940–72

Category	1940	1950	1960	1970	1972
Total U.S. population (1,000)	132,165	151,326	179,975	203,810	209,851
Total births (1,000)	[1] 2,559	[1] 3,632	[1] 4,258	3,718	[2] 3,256
Crude birth rate (per 1,000 of population)	19.4	24.1	23.7	18.2	15.6
General fertility rate (births per 1,000 females, 15–44 years of age)	79.9	106.1	119.1	87.4	73.4
Total immigration (1,000)	52.8	103.5	251.5	373	385
Immigration rate (per 1,000 of population) [3]	[4] 0.4	[4] 0.7	[4] 1.5	1.8	1.8
Total deaths (1,000)	1,417	1,452	1,712	1,921	1,962
Crude death rate (deaths per 1,000 population)	10.8	9.6	9.5	9.4	9.4
Life expectation at birth (years)	62.9	68.2	69.7	70.8	72.2
Life expectation at 5 years (years)	62.5	65.5	67.0	NA	67.8
Rate of natural increase (births-deaths, per 1,000 population)	8.6	14.5	14.2	8.4	[2] 6.2

[1] Figures adjusted for underregistration.
[2] Preliminary figures.
[3] Immigration rates for 1940, 1950, and 1960 are averages for 1931–40, 1941–50, 1951–60 respectively.
[4] Excludes Alaska and Hawaii.

Sources: National Center for Health Statistics, *Vital Statistics of the United States*, annual reports; U.S. Immigration and Naturalization Service, annual reports; and unpublished data, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Tables 65, 78, 80, and 141.

Table 35

U.S. Population Trends, by Age, 1950–73

[In thousands]

Year	Total all ages	Under 5 years	5–14 years	15–34 years	35–64 years	65 years and over	Median age
1950	152,271	16,410	24,588	46,391	52,486	12,397	30.2
1960	180,671	20,337	35,735	47,497	60,422	16,679	29.4
1970	204,879	17,167	40,688	61,750	65,094	20,177	28.0
1973	210,404	16,714	38,983	67,487	65,891	21,133	NA

NA—Not available.

Sources: U.S. Bureau of the Census, *Current Population Reports*, Series P-25, Nos. 311, 483, 493, as cited in U.S. Department of Commerce, *Statistical Abstract of the United States, 1973* (1973), Table 3, and Series P-25, No. 519.

Table 36

U.S. Population Trends, by Region, 1940–73

[In thousands]

Region [1]	1940	1950	1960	1970	1973
Total United States	**132,165**	**151,326**	**179,975**	**203,810**	**209,851**
New England	8,437	9,314	10,532	11,880	12,151
Middle Atlantic	27,539	30,164	34,270	37,272	37,528
East North Central	26,626	30,399	36,291	40,322	30,896
West North Central	13,517	14,061	15,424	16,359	16,704
South Atlantic	17,823	21,182	26,091	30,791	32,459
East South Central	10,778	11,477	12,073	12,844	13,289
West South Central	13,065	14,538	17,010	19,389	20,257
Mountain	4,150	5,075	6,916	8,344	9,149
Pacific	10,229	15,115	21,368	26,609	27,417
Puerto Rico	1,869	2,211	2,350	2,712	NA

NA—Not available.

[1] Regions:

New England—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

Middle Atlantic—New York, New Jersey, Pennsylvania.

East North Central—Ohio, Indiana, Illinois, Michigan, Wisconsin.

West North Central—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas.

South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgià, Florida.

East South Central—Kentucky, Tennessee, Alabama, Mississippi.

West South Central—Arkansas, Louisiana, Oklahoma, Texas.

Mountain—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada.

Pacific—Washington, Oregon, California, Alaska, Hawaii.

Sources: U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 14, and *Current Population Reports*, Series P-25, Nos. 500 and 508 (1974).

Table 37

U.S. Urban and Rural Population, 1950–70

[In thousands]

Class and size	1950	1960	1970
Urban			
Total	**96,469**	**125,269**	**149,326**
Places of 500,000 or more	26,591	28,595	31,736
Places of 100,000–500,000	17,721	22,418	24,728
Places of 10,000–100,000	29,606	46,355	55,987
Places of less than 10,000	15,207	18,050	21,689
Unincorporated parts of urbanized areas	7,344	9,851	15,186
Rural			
Total	**54,230**	**54,054**	**53,887**
Places under 2,500	10,054	10,391	10,508
Other rural	43,725	43,664	43,379
Total U.S. population	**150,699**	**179,323**	[1] **203,213**

[1] Excludes Hawaii and Alaska.

Source: U.S. Bureau of the Census, *U.S. Census of Population, 1970*, Vol. I, Part A, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 18.

Table 38

U.S. Population of SMSA's and Nonmetropolitan Areas, 1950–70 [1]

[In thousands]

Classification	Number of SMSA's					
	1950		1960		1970	
	243 [2]	212 [3]	264 [4]	243 [2]	264 [4]	243 [2]
Total	**150,527.0**	**150,527.0**	**179,323.2**	**179,323.2**	**203,211.9**	**203,211.9**
Metropolitan						
SMSA's	94,579.0	89,162.0	122,598.3	119,594.8	143,241.8	139,518.8
Inside central cities	NA	52,190.0	61,097.8	59,947.1	65,288.6	63,797.0
Outside central cities	NA	36,972.0	61,500.5	59,649.6	79,953.3	75,621.9
Nonmetropolitan	55,948.0	61,365.0	59,728.4	55,948.0	59,970.1	63,793.1

[1] A standard metropolitan statistical area (SMSA) always includes a city (cities) of specified population which constitutes the central city (cities) and county (counties) in which it is located. An SMSA also includes contiguous counties with economic and social relationships between the central and contiguous counties meeting specified criteria of metropolitan character and integration. An SMSA may cross state lines. In New England, SMSA's are composed of cities and towns instead of counties.

Each SMSA must include at least: a) 1 city with 50,000 or more inhabitants, or, b) a city having a population of at least 25,000 which, with the addition of contiguous places, incorporated or unincorporated, has a population density of at least 1,000 persons per square mile and together constitute, for general economic and social purposes, a single community with a combined population of at least 50,000, provided that the county or counties in which the city and contiguous places are located has a total population of at least 75,000.

[2] SMSA's recognized in the tabulation of the 1970 census.

[3] SMSA's as defined in 1960.

[4] Currently defined SMSA's, which include 21 SMSA's established since the 1970 census by the Office of Management and Budget.

Source: U.S. Bureau of the Census, *Census of Population: 1970*, Vol. I, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), pp. 850ff.

Table 39

U.S. Land Use and Government Ownership, 1950-70

[In acres]

Land use	1950	1960	1970
Land Area (million)			
Total	**2,273**	[1] **2,271**	[2] **2,264**
Farm	1,162	[1] 1,124	[2] 1,064
Grazing land [3]	402	[1] 319	[2] 288
Forest land not grazed	368	[1] 438	[2] 475
Other [4]	341	[1] 390	[2] 437
Park Area (thousands)			
Total	**29,137**	**32,321**	**38,064**
National Parks	23,836	25,704	28,543
State parks [5]	4,657	5,602	8,555
County and municipal parks	644	1,015	966
Federally owned land (million)			
Total [6]	[7] **754**	**772**	**762**
Bureau of Land Management	NA	500	474
Forest Service	180	186	187
Park Service	23.8	25.7	28.5
Fish and Wildlife Service	[7] 7	16	28
Department of Defense [8]	30	31	31
Civil works [9]	NA	15	16
Other [10]	NA	7	8

[1] 1959 data.
[2] 1969 data.
[3] Includes grasslands, arid woodlands, and other forested land grazed.
[4] Includes urban, industrial, and residential areas, rural parks, wildlife refuges, highways, railroad rights of way, ungrazed desert, rocky barren and swamp land, tundra and other land.
[5] Excludes state forests, wildlife refuges, and waysides not administered by state park agencies.
[6] Excludes outlying area beginning in 1960.
[7] 1955 data.
[8] Army (excluding Corps of Engineers), Navy and Air Force.
[9] Corps of Engineers and Bureau of Reclamation.
[10] Atomic Energy Commission, Tennessee Valley Authority and Bureau of Indian Affairs.

Sources: U.S. National Park Services, *Areas Administered by the National Park Service*, semiannual; U.S. Bureau of Outdoor Recreation, *State Outdoor Recreation Statistics—1962* (1963);National Recreation and Park Association, Arlington, Va., *State Park Statistics, 1970, Parks and Recreation* (1971), and *Recreation and Park Yearbook*; General Services Administration, *Inventory Report on the Real Property Owned by the U.S. Throughout the World*, annual; and U.S. Department of Agriculture, Economic Research Service, *Agricultural Statistics*, annual, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Tables 323, 328, 329, and 983.

Table 40

U.S. Water Use, by Category, 1940-72

[In billion gallon daily average]

Water use	1940	1950	1960	1970	1972
Total	**136.43**	**202.70**	**322.90**	**327.30**	**350.34**
Groundwater	22.56	35.19	58.17	54.27	56.27
Irrigation [1]	71.03	100.00	135.00	119.18	122.51
Public water utilities	10.10	14.10	22.00	27.03	28.34
Rural domestic [2]	3.10	4.60	4.00	4.34	4.44
Industrial and miscellaneous [3]	29.00	38.10	41.20	55.95	59.76
Steam electric utilities	23.20	45.90	98.70	120.80	135.30

[1] Total take, including delivery losses, but not including reservoir evaporation.

[2] Rural farm and nonfarm household and garden use, and water for farm stock and dairies.

[3] For 1940–1960, includes manufacturing and mineral industries, rural commercial industries, air-conditioning, resorts, hotels, motels, military and other State and Federal agencies, and other miscellaneous uses; thereafter, includes manufacturing, mining and mineral processing, ordnance, and construction.

Sources: U.S. Bureau of Competitive Assessment and Business Policy, 1940–60 based principally on committee prints of the U.S. Senate Committee on Water Resources, thereafter on *National Assessment of the Water Resources Council* (1968), as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 285.

Table 41

U.S. Water Use, by Region, 1960 and 1970

[In million gallons per day]

Region [1]	Water withdrawn [2]		Fresh water used [3]	
	1960	1970	1960	1970
United States				
Total	**250,000**	**370,000**	**60,000**	**87,000**
Surface	200,000	300,000		
New England	6,680	9,730	311.7	425
Middle Atlantic	31,800	44,300	1,150	1,490
East North Central	42,700	61,900	1,370	1,720
West North Central	12,950	20,050	3,930	7,610
South Atlantic	27,050	48,600	2,168	3,378
East South Central	13,800	19,700	1,336	1,020
West South Central	25,360	40,600	9,400	13,830
Mountain	42,200	60,300	21,800	29,400
Pacific	44,400	70,500	19,710.7	27,926
Puerto Rico	1,200	3,000	280	170

[1] Regions:

New England—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

Middle Atlantic—New York, New Jersey, Pennsylvania.

East North Central—Ohio, Indiana, Illinois, Michigan, Wisconsin.

West North Central—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas.

South Atlantic—Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida.

East South Central—Kentucky, Tennessee, Alabama, Mississippi.

West South Central—Arkansas, Louisiana, Oklahoma, Texas.

Mountain—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada.

Pacific—Washington, Oregon, California, Alaska, Hawaii.

[2] Withdrawal signifies water physically withdrawn from a source, fresh or saline. Excludes water used for hydroelectric power generation.

[3] Excludes irrigation conveyance losses by evapotranspiration.

Sources: U.S. Geological Survey, *Estimated Use of Water in the United States, 1960* (1961) and U.S. Geological Survey, *Estimated Use of Water in the United States in 1970* (1971), as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 286.

Table 42

U.S. Agricultural Inputs, 1950–72

Item	1950	1960	1970	1972
Total farms [1]	**5,648**	**3,963**	**2,954**	**2,870**
Number (thousand)				
Acreage (million acres)	1,202	1,176	1,103	1,093
Commercial farms (number, thousand)	3,706	[2] 2,416	[3] 1,734	NA
Principal crops, harvested acreage (million acres) [4]	336	316	283	284
Total irrigated land (thousand acres)	25,905	33,164	39,129	NA
Fertilizers consumed (containing primary nutrients, thousand tons)	20,345	24,374	39,902	[5] 39,896
Farm machinery [6]				
Vehicles (thousand)	9,701	10,888	10,291	7,412
Harvesters (thousand)	1,447	2,804	2,440	2,286
Labor (billion man-hours) [7]	15.1	9.8	6.5	[8] 6.4
Selected farm indices [9] (1967=100)				
Total	**101**	**97**	**102**	**103**
Farm labor	199	134	89	89
Farm real estate	105	99	100	
Mechanical power and machinery	79	91	102	103
Fertilizer and liming materials	32	54	113	122
Feed, seed, and livestock purchases	64	84	109	109
Taxes and interest	77	87	107	107
Miscellaneous	63	80	107	113

NA—Not available.

[1] Census year 1950 has been adjusted for undernumeration and for changes in definition of a farm; other years are based on trend and on indications of change in acreage and livestock surveys.

[2] 1959 data.

[3] 1969 data.

[4] Principal crops include feed grains, hay and forage, food grains, vegetables, fruits and nuts, sugar crops, cotton, tobacco, oil crops.

[5] 1971 preliminary data.

[6] Vehicles: tractors, motortrucks, cars (excludes garden tractors). Harvesters: grain combines, corn pickers, pickup balers, field forage harvesters.

[7] Man-equivalent hours: represents overhead and time used by average adult males in performing farm operations on crops and livestock.

[8] Preliminary data.

[9] Units used in indices (1967 base) are the same as in upper half of table for each category listed.

Sources: U.S. Department of Agriculture, Statistical Reporting Service, *Statistical Bulletin* #507 and supplements; U.S. Department of Agriculture, Economic Research Service, *Changes in Farm Production and Efficiency*, annual; and U.S. Bureau of the Census, *Census of Agriculture, 1969*, Vol. II, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Tables 616, 975, 982, 1004, 1009, 1010.

Table 43

U.S. Agricultural Production, 1940-72

Item	1940	1950	1960	1970	1972[1]
Wheat					
Acreage (thousand acres)	53,273	61,607	51,879	43,564	47,301
Production (million bushels)	815	1,019	1,355	1,352	1,545
Yield (bushels per acre)	15.3	16.5	26.1	31.0	32.7
Farm value (million dollars)	556	2,042	2,361	1,803	2,575
Price (dollars per bushel)[2]	0.68	2.00	1.74	1.33	1.67
Export (million bushels)[3]	40	374	631	694	NA
Cotton					
Acreage (thousand acres)	23,861	17,843	15,309	11,155	13,157
Production (million bales)	12	10	14	10	14
Yield (pounds per acre)	252	269	446	438	495
Farm value (million dollars)	621	2,006	2,154	1,122	1,744
Price (cents per pound)[2]	9.89	40.07	30.19	21.98	26.80
Export (million pounds)	1.2	4.3	6.8	3.9	NA
Tobacco					
Acreage (thousand acres)	1,410	1,599	1,142	898	843
Production (million pounds)	1,460	2,030	1,944	1,906	1,749
Yield (pounds per acre)	1,036	1,269	1,703	2,122	2,074
Farm value (million dollars)	234	1,048	1,184	1,389	1,443
Price (dollars per pound)[2]	0.16	0.52	0.61	0.73	0.83
Export (million pounds)	180	447	504	555	NA
Other crops[4]					
Acreage (thousand acres)	128,234	131,470	113,611	89,564	84,447
Production (million bushels)	3,799	4,678	5,680	5,753	7,070
Yield (bushels per acre)	77.1	95.0	137.8	172.0	208.7
Price (dollars per bushel)[2]	0.47	1.13	1.81	1.03	1.07
Export (million bushels)	180	447	504	555	NA
Vegetables[5]					
Acreage (thousand acres)	3,262	3,722	3,383	3,198	3,210
Production (million tons)	11,422	15,204	18,398	20,601	21,644
Farm value (million dollars)	308	834	1,125	1,648	2,023

See footnotes at end of table.

Table 43—Continued

U.S. Agricultural Production, 1940–72—Continued

Item	1940	1950	1960	1970	1972 [1]
Hay					
Acreage (thousand acres)	73,058	75,150	67,313	61,492	59,783
Production (million tons)	96	104	118	127	128
Yield (tons per acre)	1.31	1.38	1.76	2.06	2.15
Farm value (million dollars)	.943	2,222	2,410	3,078	3,750
Price (dollars per ton) [2]	9.82	21.10	21.70	26.10	31.40
Export (thousand tons)	6	23	52	131	NA
Cattle and calves					
Number on farms (thousand)	68,309	77,963	96,236	112,369	117,862
Farm value (million dollars)	2,770	9,630	13,150	20,160	24,520
Price (dollars per 100 pounds) [2]	NA	23.30	20.40	27.10	33.50
Chickens and turkeys					
Number on farms (thousand)	446,857	461,673	375,117	431,010	NA
Farm value (million dollars)	283	655	419	582	NA
Price (cents per pound) [2]	NA	27.6	18.8	15.8	15.6
Other animals [6]					
Number on farms (thousand)	NA	NA	92,196	87,856	80,212
Farm value (million dollars)	NA	NA	1,638	2,097	3,003
Price (dollars per 100 pounds) [2]	NA	14.80	10.45	15.10	16.20

NA—Not available.
[1] Preliminary data.
[2] Average price for year.
[3] Includes flour.
[4] Corn, oats, sorghum.
[5] Artichokes, asparagus, lima beans, snap beans, beets, broccoli, brussel sprouts, cabbage, cantaloupe, carrots, cauliflower, celery, sweet corn, cucumbers, eggplant, garlic, honeydew melons, kale, lettuce, onions, green peas, green peppers, shallots, spinach, tomatoes, watermelons (lima beans, beets, kale, green peas, shallots discontinued in 1968).
[6] Hogs, pigs sheep, lambs.

Sources: U.S. Department of Agriculture, Statistical Reporting Service, *Agricultural Statistics, 1967* (1967), Tables 1, 38, 50, 71, 85, 150, 163, 170, 180, 192, 224, 300, 395; U.S. Department of Agriculture, Economic Research Service, *Agricultural Statistics, 1973* (1973), Tables 1, 38, 49, 76, 84, 145, 158, 164, 174, 186, 215, 292, 386, and 1020.

Table 44

U.S. Pesticide Production, 1967-71

[In thousand pounds]

	1967	1968	1969	1970	1971 [1]
Fungicides					
Copper naphthenate	3,473	1,718	1,545	1,730	1,695
Copper sulfate [2]	33,992	37,192	42,072	28,768	31,112
Dithiocarbamic acid salts	(3)	(3)	(3)	39,391	35,110
Ferbam	2,331	1,900	[4] 1,500	(3)	(3)
Nebam	1,361	[4] 2,000	1,938	(3)	(3)
Zineb	3,055	3,081	[4] 2,500		
Mercury fungicides	912	1,448	941	1,114	601
Pentachlorophenol (PCP) [5]	44,239	48,575	45,988	47,170	50,877
2,4,5-Trichlorophenol and salts	25,254	28,066	(3)	(3)	(3)
Other organic fungicides	63,269	66,793	85,607	[6] 50,307	60,875
Total [7]	**177,886**	**190,773**	**182,091**	**168,470**	**180,270**
Herbicides					
2,4-D acid [8]	(77,139)	(79,263)	(47,077)	(43,576)	(3)
2,4-D acid, esters, and salts	83,750	94,116	56,998	(3)	(3)
DNBP, ammonium salts	58	(3)	(3)	(3)	(3)
Maleic hydrazide	(3)	(3)	2,771	3,271	(3)
Methanearsonic acid salts	(3)	(3)	(3)	30,454	24,476
Phenyl mercuric acetate (PMA) [9]	518	582	534	457	337
Silvex	(3)	(3)	1,597	2,016	(3)
Sodium chlorate [10]	30,000	30,000	30,000	30,000	30,000
2,4,5-T acid [8]	(14,552)	(17,530)	(4,999)	(3)	(3)
2,4,5-T acid, esters, and salts	27,189	45,542	11,626	12,335	(3)
Other organic herbicides	206,759	235,541	268,238	[6] 312,132	404,036
Total	**439,965**	**499,514**	**423,840**	**434,241**	**458,849**

Insecticides, fumigants, rodenticides [11]					
Aldrin-toxaphene group [12]	120,183	115,974	107,311	88,641	116,264
Calcium arsenate	[6] 2,040	3,398	[6] 1,158	[6] 1,144	940
DDT	103,411	139,401	123,103	59,316	940
Dibromochloropropane	5,240	7,887	8,611	(3)	(3)
Lead arsenate	5,952	9,016	[6] 9,204	[6] 4,156	6,168
Methyl bromide [13]	19,665	20,454	20,033	21,147	(3)
Organophosphorus insecticides [8]	(3)	(3)	(3)	132,496	(138,185)
Methyl parathion	33,344	38,163	50,572	41,353	37,226
Parathion	11,361	[4] 20,000	(3)	15,259	(3)
Other	(3)	(3)	(3)	75,884	100,959
Other organic insecticides	202,600	227,326	260,892	188,632	303,261
Total	[6] **503,796**	**581,619**	[6] **580,884**	[6] **495,432**	**564,818**
Grand total	[6] **1,029,956**	**1,175,173**	[6] **1,134,739**	[6] **1,054,467**	**1,203,937**

1 Preliminary.
2 Shipments by producers to agriculture (including for use as a minor plant nutrient).
3 Withheld to avoid disclosure. Figure included in totals.
4 Estimated.
5 Not only a wood preservative for wood rot control but also a herbicide and desiccant.
6 Revised.
7 Sulfur not included may amount to 150 million pounds.
8 Figures in parentheses represent duplication but are included in totals to be comparable with the 1971 total.
9 Also a fungicide.
10 Estimated shipments to producers of herbicides and defoliants.
11 Includes a small quantity of synthetic soil conditioners; does not include the fumigants carbon tetrachloride, carbon disulfide, ethylene dibromide, and ethylene dichloride, which have many other uses; nor does it include paradichlorobenzene (classed by the Tariff Commission as an intermediate) or inorganic rodenticides.
12 Includes aldrin, chlordane, dieldrin, endrin, heptachlor, Strobane (R), and toxaphene.
13 Fumigant for control of both insects and weeds.

Sources: U.S. Tariff Commission, U.S. Bureau of the Census, U.S. Bureau of Mines, and the chemical industry.

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Table 45

Estimated U.S. Pesticide Use

[In million pounds, active ingredient]

Type of pesticide [1]	Total U.S. use			Farm use			Farmers' share of total (percent)	
	1966	1971	Percent increase 1966–71	1966	1971	Percent increase 1966–71	1966	1971
Herbicides	227	359	58	125	251	101	55	70
Insecticides	329	319	–3	195	201	3	59	63
Fungicides	125	155	24	33	42	27	26	27
Total	**681**	**833**	**22**	**353**	**494**	**40**	**52**	**59**

[1] Herbicides include plant growth regulators, defoliants, desiccants; insecticides include miticides, rodenticides, fumigants. Excluded are sulfur, creosote, petroleum oils, and several other pesticides.

Sources: U.S. Department of Agriculture, *Quantities of Pesticides Used by Farmers in 1966*, Agricultural Economic Report No. 179 (1970); and U.S. Department of Agriculture, Economic Research Service, *Quantities of Pesticides Used by Farmers in 1971* (1974).

Table 46

U.S. Forests: Area and Growing Stock, 1953–70

Year	Total forest land (million acres)	Commercial forest land ownership (million acres) [1]				Growing stock (billion cubic feet)
		Total	Federal	State county, or municipal	Private	
1953	748	495	111	28	356	517
1963	757	508	111	28	369	628
1970	754	500	107	29	364	649

[1] All land (a) producing or physically capable of producing 20 cu. ft. of wood per year, (b) economically available on the date shown or prospectively, and (c) not withdrawn from timber utilization.

Sources: U.S. Forest Service, *Timber Resources for America's Future* (1958), *Timber Trends in the United States* (1965), and unpublished data, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 1048.

Table 47

U.S. Forest Products: Production, Consumption, and Foreign Trade, 1950–70

[In millions of dollars]

Activity	1950		1960		1970	
	Value [1]	Quantity	Value [2]	Quantity	Value [3]	Quantity
Production						
Total	**2,983**	NA	**2,941**	NA	**3,210**	NA
Lumber (million board feet) [4]	1,816	38,007	1,645	32,926	1,731	34.668
Softwoods	NA	30,633	NA	26,672	NA	27,530
Hardwoods	NA	7,374	NA	6,254	NA	7,138
Woodpulp (million cubic feet)	388	1,500	565	2,575	781	3,835
Other forest products	779	NA	731	NA	698	NA
Consumption						
Total	**3,275**	NA	**3,271**	NA	**3,577**	NA
Saw logs (million cubic feet)	1,920	6,360	1,835	5,560	1,985	6,110
Pulpwood logs (million cubic feet)	574	2,385	721	3,290	945	4,405
Other Products	780	NA	714	NA	647	NA
Exports, logs (million cubic feet)	98	10	172	45	309	430
Imports, logs (million cubic feet)	390	45	502	20	676	25

[1] All values in 1967 dollars; values for 1950 are average values for the period 1950–1954.
[2] Values for 1960 are 1960–1964 average.
[3] 1969 value.
[4] Includes cedar, douglas fir, hemlock, ponderosa pine, redwood, southern yellow pine, white fir, white pine, ash, beech, cottonwood, elm, maple, oak, sweet (red and sap) gum, tupelo and black gum, and yellow poplar.
NA=Not available.

Sources: U.S. Forest Service, *The Demand and Price Situation for Forest Products,* annual; U.S. Bureau of the Census, reports of Census of Manufactures and Current Industrial Reports, series M24T; and Mackay-Shields Economics, Inc., New York, N.Y., as cited in the U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Tables 1059 and 1061.

Table 48

U.S. Forests: Net Annual Growth and Removal of Sawtimber and Growing Stock, 1952–70

[Sawtimber in billion board feet, growing stock in billion cubic feet]

Region	All species						Softwoods [1]						Hardwoods [2]					
	Sawtimber [3]			Growing stock [4]			Sawtimber [3]			Growing stock [4]			Sawtimber [3]			Growing stock [4]		
	1952	1962	1970	1952	1962	1970	1952	1962	1970	1952	1962	1970	1952	1962	1970	1952	1962	1970
North																		
Net growth	9.4	11.5	13.7	4.1	4.9	4.4	2.4	2.8	3.6	1.1	1.2	1.4	7.0	8.6	10.1	3.0	3.6	4.2
Removals	9.4	6.5	9.0	2.1	2.1	2.4	1.9	1.5	2.1	0.6	0.6	0.6	4.8	5.0	6.8	1.5	1.5	1.8
North																		
South																		
Net growth	21.2	24.3	28.0	6.3	7.5	8.6	13.6	16.7	20.1	3.6	4.5	5.4	7.6	7.6	7.9	2.7	3.0	3.2
Removals	20.2	17.2	22.8	5.7	5.4	6.5	11.9	9.8	15.0	3.1	2.8	4.0	8.3	7.3	7.8	2.6	2.6	2.5
Rocky Mountains																		
Net growth	4.3	4.6	6.1	1.2	1.3	1.4	4.2	4.5	4.9	1.1	1.2	1.3	0.1	0.1	0.1	0.1	0.1	0.1
Removals	3.2	4.3	5.4	0.5	0.7	0.9	3.2	4.3	5.4	0.5	0.7	0.9	[5]	[5]	[5]	[5]	[5]	[5]
Pacific Coast																		
Net growth	10.3	11.9	13.1	2.3	2.7	3.1	9.4	10.7	11.6	2.0	2.3	2.6	0.9	1.2	1.5	0.3	0.4	0.5
Removals	22.4	22.3	25.6	3.5	3.6	4.2	22.3	22.1	25.2	3.5	3.5	4.1	0.1	0.2	0.4	[5]	0.1	0.1
Total United States																		
Net growth	**45.1**	**52.3**	**59.9**	**13.9**	**16.4**	**18.6**	**29.5**	**34.7**	**40.3**	**7.8**	**9.3**	**10.7**	**15.6**	**17.6**	**19.7**	**6.1**	**7.1**	**7.9**
Removals	**52.5**	**50.3**	**62.8**	**11.8**	**11.8**	**14.0**	**39.2**	**37.7**	**47.7**	**7.8**	**7.6**	**9.6**	**13.3**	**12.6**	**15.0**	**4.1**	**4.2**	**4.4**

Note: Figures may not add due to rounding.

[1] Coniferous trees, usually evergreen, having needles or scalelike leaves.
[2] Dicotyledon trees, usually broad-leaved and deciduous.
[3] Live trees of commercial species containing at least one 12-foot saw log or two non-contiguous 8-foot logs and meeting regional specifications for freedom of defects. Softwood trees must be at least 9.0 inches in diameter at breast height; hardwood trees must be at least 11.0 inches.
[4] Live trees of commercial species qualifying as desirable or acceptable trees. Excludes rough, rotten, or dead trees.
[5] Less than 0.1 billion.

Source: U.S. Forest Service, *Timber Outlook for the United States* (1973).

Table 49

World Commercial Fish Harvest, by Region, 1966–72

Year	Africa	North and Central America	South America	Asia	Europe	Oceania	USSR	World total
1966	3,400	4,460	11,130	21,270	11,570	170	5,350	57,300
1967	3,780	4,400	12,200	22,040	12,070	80	5,780	60,400
1968	4,260	4,670	13,010	23,840	11,890	190	6,080	63,900
1969	4,300	4,560	11,350	24,440	11,340	170	6,500	62,700
1970	4,090	4,900	14,860	26,250	11,980	190	7,250	69,500
1971	3,720	5,040	13,220	28,070	12,060	220	7,340	69,700
1972	4,110	4,810	7,470	28,850	12,380	230	7,760	65,600

Source: UN Food and Agriculture Organization, *Yearbook of Fishery Statistics, 1972* (1973), Vol. 34.

Table 50

U.S. Commercial Fish Harvest, 1950–72

[In thousand metric tons and million dollars]

	1950[1]		1960		1970		1972	
	Catch	Value	Catch	Value	Catch	Value	Catch	Value
Fish								
Flounder	59.52	12	57.66	13	76.72	23	76.73	29
Halibut, Pacific	23.15	8	23.15	6	15.89	9	12.26	13
Herring, sea	165.26	3	108.51	4	35.87	2	46.31	3
Menhaden	465.80	10	916.17	20	834.0	34	880.31	31
Salmon, Pacific	149.37	37	106.7	45	186.14	99	98.52	63
Tuna [2]	177.51	61	135.3	38	178.42	75	171.61	90
Shell fish								
Shrimp	86.71	43	113.05	67	166.62	130	174.79	193
Clams and oysters	53.11	41	49.94	41	69.46	58	64.47	66
Crabs and lobsters	82.63	17	114.86	31	139.95	72	140.74	95

[1] Excludes Hawaii.
[2] Excludes landings of tuna by U.S. vessels in Puerto Rico.

Source: U.S. National Oceanic and Atmospheric Administration, *Fishery Statistics of the United States*, annual, and *Fisheries of the United States*, annual, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 1077.

Table 51

World Commercial Harvest of Fish and Other Aquatic Life, 1965–72

[In metric tons and millions of dollars]

Category	1965	1966	1967	1968	1969	1970	1971	1972
Marine fish	39,640	42,990	45,950	48,660	47,220	52,490	52,040	47,430
Freshwater fish	7,020	7,320	7,170	7,360	7,610	8,060	8,570	8,580
Mollusks	2,960	3,010	3,160	3,490	3,250	3,310	3,210	3,520
Diadromous fish [1]	1,530	1,860	1,790	1,910	2,190	3,050	3,110	3,370
Crustaceans	1,210	1,290	1,380	1,480	1,510	1,630	1,680	1,670
Aquatic plants	650	680	820	840	760	870	920	890
Miscellaneous aquatic animals and products	240	140	150	130	100	130	120	130
Whales, seals, and aquatic mammals [2]	0	10	0	0	10	10	10	10
Selected major species								
Blue whales	57,891	52,238	47,485	42,728	43,217	39,007	30,683	
Herring	16,851	18,788	19,664	20,463	18,113	21,374	19,431	13,538
Cod	6,794	7,309	8,350	9,617	9,941	10,535	10,681	11,472

Salmon	880	1,165	1,077	1,181	1,401	2,095	2,164	2,451
Shad	591	638	644	654	673	835	810	750
Carp	278	292	316	315	323	347	351	437
Squids	856	834	972	1,211	974	939	894	1,086
Oysters	742	762	839	882	764	710	728	770
Shrimp	695	733	797	831	853	944	1,008	1,024
Clams	564	612	596	590	637	661	598	616
Lobsters	96	96	89	101	100	90	96	92
Brown seaweeds	366	374	441	468	418	416	469	498
Red seaweeds	205	215	284	279	247	363	363	306

Foreign trade	1967		1969		1971		1972	
	Weight	Value	Weight	Value	Weight	Value	Weight	Value
Total imports	6,972	2,410	7,311	2,787	7,431	3,716	8,240	4,507
Total exports	7,055	2,114	7,093	2,441	7,455	3,263	7,801	3,808

[1] Fish that migrate between fresh and salt water.
[2] Excluding blue whales.

Source: UN Food and Agriculture Organization, *Yearbook of Fishery Statistics, 1972* (1973).

Table 52

World and U.S. Mineral Statistics, 1950–71

	1950				1960				1970				1971			
	World	United States			World	United States			World	United States			World	United States		
	Production	Production	Consumption	Value	Production	Production	Consumption	Value	Production	Production	Consumption	Value	Production	Production	Consumption	Value
FUELS																
Coal (million short tons) [1]	1,997	560	494	2,893	2,906	435.9	398	2,091	3,295	626.0	525	3,818	3,309	561	[2] 511	4,005
Petroleum (million barrels crude) [3]	3,803	1,974	2,375	4,962	7,674	2,609	3,611	7,420	16,690	3,505	5,365	11,174	17,673	3,454	[2] 5,523	11,693
Natural gas (billion cubic feet) [4]	NA	6,280	6,026	409	NA	12,771	12,509	1,790	NA	21,921	22,046	3,746	NA	22,493	22,677	4,077
NONMETALS																
Gypsum (million short tons) [5]		8.2			43.2	9.9		35.7	57.2	9.2		35.1	[2] 58.6	10.4		39.0
Nitrate (agricultural, million short tons) [6]					10.8	2.8		NA	33.7	8.4		NA	[2] 36.2	[2] 8.5		
Phosphate rock (million short tons)	25.8	12.5	[7] 9.6	63.3	46	19.6	14.9	117	94	38.7		203.2	96.5	38.9	27.8	203.8
Potash (million short tons)	5.3	1.3	[7] 1.4	[8] 45.3	10.0	2.6	2.3	89.7	20.4	2.7		98.1	22.1	2.6	4.8	100.5
Sulfur (million short tons) [9]					10.3	5.8		117.2	21.7	9.5		151.8	22.5	9.6		118
METALS																
Aluminum (million short tons) [10]	1.6	0.96	1.2	316	4.9	2.3	2.0	1.2	10.6	4.8	4.5	2.6	11.3	4.7	5.0	2.6

Copper (million short tons) [11]	3.3	0.9			5.0	1.1			6.7	1.6			6.7	1.4		
Iron ore (million short tons)	247	98		488	5.4	89		[12] 724	754	90		942	773	81		891
Lead (million short tons) [13]		0.4		NA	2.6	0.25		58	3.7	0.6		179	3.7	0.6		891
Magnesium (thousand short tons) [14]	50	15.7	18.1		102.5	40.1	37.1		243	112	93.5		257	123.5	99	
Uranium oxide (U_3O_8 thousand short tons)					[15] 41	18			24	12.9			25	13.2		
Zinc (million short tons) [16]					3.6	0.4		112	6.0	0.5		178	[2] 6.1	0.49		162

NA—Not available.
[1] Includes bituminous, lignite, Pennsylvania anthracite, and other anthracite.
[2] Preliminary.
[3] Prior to 1960 excludes Alaska and Hawaii. Consumption figures for petroleum are for products refined and processed from crude oil, including still gas, liquefied refinery gas, and natural gas liquids. There are 42 gallons in a barrel of crude petroleum.
[4] Marketed production.
[5] Mined. Excludes Alaska, Hawaii, and Puerto Rico.
[6] U.S. production includes Puerto Rico. For years ended June 30.
[7] Consumption is defined as the amount sold or used plus imports minus exports.
[8] Value derived from reported value of amount used.
[9] Excludes Alaska and Hawaii.
[10] Includes both primary and secondary aluminum (recovered from scrap).
[11] Smeltered only; 1950 figures are average of 1951–55.
[12] Beginning 1960 the value excludes byproduct ore.
[13] Content of ore and concentrates value includes Alaska.
[14] Primary only.
[15] World production figure excludes USSR.
[16] Ore and concentrate.

Sources: U.S. Bureau of Mines, *Mineral Yearbook*, annual; and U.S. Department of the Interior, *United States Energy Through the Year 2000* (1973).

Table 53

U.S. Energy Consumption, by Category, 1950–73

[In quadrillion BTU's]

Use	1950 [1]	1960	1970	1972	1973	Annual growth rate, average of period (percent)			
						1950–60	1960–70	1970–72	1972–73
Total gross energy input [2]	34.0	44.6	67.4	72.1	75.6	4.2	5.1	3.0	4.0
Conversion losses [3]	4.3	6.4	11.4	12.6	13.4	4.8	7.8	5.0	6.0
Net	29.7	38.2	56.0	59.5	62.2	2.9	4.6	3.0	4.0
Industrial									
Coal [4]	6.0	4.7	5.0	4.3	4.4	−2.1	6.0	−7.0	2.0
Petroleum [5]	2.6	3.7	5.3	5.7	6.0	4.2	4.3	3.5	5.0
Natural gas	3.8	6.3	10.2	10.6	10.8	6.5	6.1	1.5	1.0
Electricity [6]	.56	1.3	2.2	2.5	2.7	13.2	6.9	6.5	8.0
Total	12.96	16.0	22.7	23.1					
Transportation [7]									
Coal	1.7	0.087	0.008	0.004	0.005	−9.5	−9.0	−25.0	25.0
Petroleum	6.8	10.4	15.6	17.3	17.9	5.2	5.0	5.0	3.0
Natural gas	0.13	0.36	0.74	0.79	0.81	17.6	10.5	3.0	2.0
Electricity	0.024	0.018	0.016	0.017	0.018	−2.5	−1.1	3.0	5.0
Total	8.65	10.86	16.36	18.11	18.73				

Commercial and residential									
Coal	2.9	0.98	0.43	0.39	0.37	−6.6	−5.6	−4.5	−5.0
Petroleum	3.0	4.9	6.4	6.7	7.0	6.3	3.0	2.0	5.0
Natural gas	1.6	4.3	7.1	7.6	8.0	16.8	6.5	3.5	5.0
Electricity	0.55	1.3	3.0	3.5	3.7	31.8	13.0	8.0	5.0
Total	8.05	11.48	16.93	18.19	18.47				

[1] Excludes Alaska and Hawaii.

[2] Gross energy is the total of inputs into the economy of the primary fuels (petroleum, natural gas, and coal, including imports) or their derivatives, plus the generation of hydro and nuclear power converted to equivalent energy inputs.

[3] Losses caused by converting a primary energy source to a secondary energy source.

[4] Includes anthracite, bituminous, and lignite coals.

[5] Petroleum products refined and processed from crude oil, including still gas, liquefied refinery gas, and natural gas liquids.

[6] Utility electricity generated and imported, distributed on basis of historical series in the Edison Electric Institute Yearbook. Conversion of electricity to energy equivalent was made at the value of containing energy corresponding to 100 percent efficiency using a theoretical rate of 3,412 BTUs per kilowatt hour.

[7] Includes bunkers and military transportation.

Sources: Council on Environmental Quality, *A National Energy Conservation Program: The Half and Half Plan* (1974), and U.S. Department of the Interior, *United States Energy Through the Year* 2000 (1972), as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States*, 1973 (1973), Table 832.

Table 54

U.S. Energy Consumption for Electricity Production, 1950–73

[In quadrillion BTUs]

Energy source	1950	1960	1970	1973[1]
Coal [2]	2.228	4.251	7.583	8.691
Oil [3]	0.662	0.564	2.087	3.435
Natural gas[4]	0.651	1.785	4.015	3.918
Nuclear	....	0.006	0.229	0.853
Hydro [5]	1.44	1.657	2.65	2.906

[1] Preliminary data.
[2] Includes anthracite, bituminous coal, and lignite.
[3] Petroleum products, including still gas, liquefied refinery gas, and natural gas liquids.
[4] Excludes natural gas liquids.
[5] Includes minor amount of geothermal.

Sources: U.S. Department of the Interior, *United States Energy Through the Year 2000* (1972); and *Minerals Yearbook 1972* (1973), as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Table 833.

Table 55

U.S. Wholesale Price Index, by Commodity, 1960–72

Commodity group [1967=100]	1960	1970	1972 [1]
Farm products	97.2	111.0	125.0
All foods	92.1	113.5	121.8
Hides, skins, leather, and related products	90.8	110.1	131.3
Fuels and related products and power	96.1	105.9	118.6
Chemical and allied products	101.8	102.3	104.2
Rubber and plastic products	103.1	108.6	109.3
Lumber and wood products	95.3	113.7	144.3
Metals and metal products	92.4	116.7	123.5
Furniture and household durables	99.0	107.5	111.4
Tobacco products	90.3	114.0	117.5
Industrial commodities [2]	95.3	110.0	117.9
All commodities	94.9	110.4	119.1

[1] Preliminary.
[2] Prior to January 1967, classified as "all commodities other than farm products and processed foods."

Source: U.S. Department of Agriculture, *Agricultural Statistics, 1972* (1973), Table 661.

Table 56

U.S. Recreational Statistics: Visits to Recreational Areas, 1950–73

[In thousands]

Recreational area	1950		1960		1970		1973	
	Visits	Overnight stays	Visits	Overnight stays	Visits	Overnight stays	Visits	Overnight stays
State parks	111,291	6,079	259,001	20,569	482,536	50,572	NA	NA
National Parks [1]	33,253	4,501	79,229	9,365	172,005	16,160	215,580	15,349
National Forests	27,368	[2] 5,760	92,592	15,454	172,559	38,477	188,175	39,751
Total United States	**174,912**	**16,340**	**430,822**	**45,388**	**827,095**	**105,209**	**NA**	**NA**

NA—Not available.

[1] Visits for calendar year 1950 not adjusted for comparability with counting system as modified in 1960. Prior to 1965 excludes visits to the White House.

[2] No category for overnight stays in National Forest data 1950. Includes campground use and hotel and resort visits.

Sources: National Recreation and Park Association, *State Park Statistics, 1970;* U.S. National Park Service, annual reports on recreational use; Outdoor Recreation Review Commission, *Outdoor Recreation for America* (1962); U.S. Forest Service, *Recreation Use of the National Forests,* annual; and unpublished data from the U.S. Department of the Interior, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1973* (1973), Tables 323, 326, 328.

Table 57

U.S. Recreational Statistics: Participation in Selected Outdoor Activities, 1960 and 1970

[In millions]

Activity	Number of occasions,[1] 1960	Total person-days of participation, 1970 [2]
Outdoor swimming	672	744
Hunting and fishing	355	577
Walking for pleasure	566	496
Playing outdoor games and sports	474	483
Driving for pleasure	872	405
Picnicking	279	405

[1] Number of separate days on which persons 12 years of age or over engaged in activity June through August, except for hunting, for which the September-November period was used.

[2] Participation by a person 12 years of age or older in an activity during any part or parts of a calendar day is counted as a person-day.

Sources: Outdoor Recreation Resources Review Commission, *Outdoor Recreation for America* (1962); and unpublished data from U.S. Bureau of Outdoor Recreation, as cited in U.S. Bureau of the Census, *Statistical Abstract of the United States, 1972* (1973), Table 336.

Table 58

U.S. Air Pollutant Emissions Trends, Total Emissions, 1940–70

[In million tons per year]

	Sulfur dioxide	Particulates	Carbon monoxide	Hydrocarbons	Nitrogen oxides
1940 controllable	22.2	19.2	42.5	10.1	5.5
Miscellaneous (uncontrollable)[1]	0.6	25.7	30.5	6.5	1.0
Total	**22.8**	**44.9**	**72.5**	**16.6**	**6.5**
1950 controllable	24.3	20.8	62.3	15.6	8.2
Miscellaneous (uncontrollable)	0.6	12.4	20.6	6.2	0.6
Total	**24.9**	**33.2**	**82.9**	**21.8**	**8.8**
1960 controllable	22.6	21.0	79.3	18.8	10.9
Miscellaneous (uncontrollable)	0.6	8.9	19.3	7.0	0.5
Total	**23.2**	**29.9**	**98.6**	**25.8**	**11.4**
1968 controllable	30.5	22.5	93.4	22.1	19.1
Miscellaneous (uncontrollable)	0.6	5.9	18.0	7.6	0.4
Total	**31.1**	**28.4**	**111.4**	**29.7**	**19.5**
1969 controllable	31.9	22.8	97.6	21.9	20.6
Miscellaneous (uncontrollable)	0.2	12.2	17.5	6.8	0.5
Total	**32.1**	**35.0**	**115.1**	**28.7**	**21.1**
1970 controllable	33.3	22.3	96.0	22.5	22.0
Miscellaneous (uncontrollable)	0.1	3.2	4.7	4.8	0.1
Total	**33.4**	**25.5**	**100.7**	**27.3**	**22.1**

[1] Uncontrollable sources include forest fires, structural fires, coal refuse banks, some agricultural burning, and some solvent evaporation.

Source: U.S. Environmental Protection Agency, *National Air Monitoring Program: Air Quality and Emissions Trends* (1973).

Table 59

U.S. Air Pollutant Emissions Trends, Rates of Change

[In percent]

	1940–70	1940–60	1940–70
Carbon monoxide			
Total	**1.1**	**1.5**	**0.2**
Road vehicles	4.0	4.3	3.4
Hydocarbons			
Total	**1.7**	**2.2**	**0.6**
Road vehicles	3.3	4.3	1.0
Nitrogen oxides			
Total	**4.2**	**2.9**	**6.8**
Road vehicles	4.8	4.9	4.6
Fuel combustion	3.7	2.0	7.3
Steam-electric utilities	6.6	6.5	6.7
Sulfur oxides			
Total	**1.3**	**0.6**	**2.6**
Fuel combustion	1.5	0.2	4.2
Steam-electric utilities	6.6	6.5	6.7
Industrial process	1.9	1.3	3.0
Particulates			
Total	**—1.9**	**—2.0**	**—1.6**
Industrial process	1.4	1.5	1.1
Fuel combustion	−1.1	−1.1	−1.1
Steam-electric utilities	2.1	4.1	−1.8
Population—U.S. total	1.45	1.53	1.27

Source: Environmental Protection Agency, *National Air Monitoring Program Air Quality and Emissions Trends* (1973).

Table 60

U.S. Ambient Air Quality Trends, by Monitoring Station, 1969–72

	Number of stations			
	1969	1970	1971	1972
Suspended particulates				
Total stations with year's valid data [1]	667	644	640	1,589
Exceeding annual secondary standard [2]	638	459	426	871
Exceeding annual primary standard	335	319	275	516
Total stations with 1 or more valid quarters	1,095	1,002	1,313	2,683
Exceeding 24-hour secondary standard	594	530	628	1,100
Exceeding 24-hour primary standard	184	161	140	261
Sulfur dioxide				
Total stations with year's valid data [1]	178	155	153	500
Exceeding annual primary standard	24	19	4	9
Total stations with 1 or more quarter's valid data	234	276	409	1,064
Exceeding 24-hour secondary standard [2]	72	52	60	24
Exceeding 24-hour primary standard	54	34	47	10
Carbon monoxide				
Total stations with 1 or more quarter's valid data [1]	33	48	58	128
Exceeding 1-hour standard	3	10	7	13
Exceeding 8-hour standard	29	39	53	95
Total oxidants or ozone				
Total stations with 1 or more quarter's valid data [2]	38	45	50	111
Exceeding 1-hour standard	37	43	50	93

[1] Sufficient data available from which statistics can be calculated.
[2] Considered air quality guides rather than standards.

Source: Environmental Protection Agency, *National Air Monitoring Program: Air Quality and Emissions Trends* (1973).

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Table 61

U.S. Ambient Air Quality Trends, by Air Quality Control Region (AQCR), 1969–72

Status	Priority[1] I				II				III				Totals			
	1969	1970	1971	1972	1969	1970	1971	1972	1969	1970	1971	1972	1969	1970	1971	1972
Suspended particulates																
Total AQCRs in each priority class	120	120	120	120	70	70	70	70	57	57	57	57	247	247	247	247
AQCRs reporting sufficient quarterly or annual data	107	106	110	118	52	48	48	63	21	19	23	37	180	173	181	218
AQCRs meeting all standards	11	7	12	3	17	20	18	91	14	12	8	9	42	39	38	21
AQCRs exceeding any secondary standard or guide	96	99	98	113	35	28	30	49	7	7	15	23	138	134	143	185
AQCRs exceeding primary standard	86	88	75	102	15	14	17	22	4	4	8	14	105	106	100	138
AQCRs exceeding secondary 24-hr standard	89	87	89	110	26	19	24	41	7	7	15	20	122	113	128	171
AQCRs exceeding primary 24-hr standard	56	57	52	77	6	5	6	10	4	3	5	12	66	65	63	99
AQCRs reporting sufficient annual data	96	96	86	110	41	36	31	53	12	11	18	28	149	143	135	191
AQCRs exceeding secondary annual guide	81	89	73	103	28	23	22	38	4	5	9	16	113	117	104	157
AQCRs exceeding primary annual standard	73	82	65	93	13	13	15	20	12	2	7	9	88	97	87	122
AQCRs reporting only sufficient quarterly data	11	10	24	8	11	12	17	10	9	8	5	9	31	30	46	27
AQCRs reporting insufficient data to compare to NAAQS	13	14	10	2	18	22	22	7	36	38	34	20	67	74	66	29
Sulfur dioxide																
Total AQCRs in each priority class	60	60	60	60	41	41	41	41	146	146	146	146	247	247	247	247
AQCRs reporting sufficient quarterly or annual data	37	42	42	52	19	22	24	31	33	48	53	79	89	88	119	162

AQCRs meeting all standards	23	31	26	29	14	16	15	23	32	47	51	53	69	94	92	105
AQCRs exceeding any secondary standard or guide	14	11	16	NA	5	6	9	NA	1	1	2	NA	20	18	27	NA
AQCRs exceeding any primary standard	12	10	15	13	4	5	9	4	1	1	2	2	17	16	26	19
AQCRs exceeding secondary 24-hr standard	13	11	16	NA	5	5	9	NA	1	1	2	NA	19	17	27	NA
AQCRs exceeding primary 24-hr standard	11	9	15	13	3	3	9	4	1	1	2	2	15	13	26	19
AQCRs exceeding secondary 3-hr standard	6	5	6	6	1	0	1	1	0	0	0	0	7	5	7	7
AQCRs reporting sufficient annual data	30	32	28	41	18	16	17	27	27	22	20	55	75	70	65	123
AQCRs exceeding secondary annual guide	10	7	7	NA	2	3	3	NA	0	0	0	NA	12	10	10	NA
AQCRs exceeding primary annual standard	6	5	3	4	1	2	0	0	0	0	0	0	7	7	3	4
AQCRs reporting only sufficient quarterly data	7	10	14	11	1	6	7	4	6	26	33	24	14	42	54	39
AQCRs reporting insufficient data to compare to NAAQS	23	18	18	8	22	19	17	10	113	98	93	67	158	135	128	85
Carbon monoxide																
Total AQCRs in each priority class	29	29	29	30	NA	NA	NA	NA	218	218	218	217	247	247	247	247
AQCRs reporting sufficient quarterly or annual data	11	11	13	22	NA	NA	NA	NA	5	3	8	26	16	14	21	48
AQCRs exceeding any primary standard	11	11	13	21	NA	NA	NA	NA	3	3	8	21	14	14	21	42
Oxidants																
Total AQCRs in each priority class	54	54	54	55	NA	NA	NA	NA	193	193	193	192	247	247	247	247
AQCRs reporting sufficient quarterly or annual data	9	13	15	31	NA	NA	NA	NA	0	0	0	7	9	13	15	38
AQCRs exceeding the primary standard	9	12	15	25	NA	NA	NA	NA	0	0	0	3	9	12	15	28

NA—Not available. NAAQS—National Ambient Air Quality Standards.

[1] Priority classification of each AQCR is determined by EPA for each pollutant category; Priority I is most severe, Priority III least severe.

Sources: Environmental Protection Agency, *Monitoring and Air Quality Trends Report 1972* (1973); and *National Air Monitoring Program: Air Quality and Emissions Trends, 1973*, (1973).

Table 62

U.S. Water Quality Trends, 1963–72

Parameter	Reference level [1]	Percent of reaches exceeding reference levels		
		1963–72	1968–72	Change
Suspended solids	80mg/1-aquatic life [2]	26	14	−12
Turbidity	50JU-aquatic life [2]	28	28	0
Temperature	90°F-aquatic life [2]	0	0	0
Color	75 platinum-cobalt units-water supply [3]	0	0	0
Ammonia	0.89mg/1-aquatic life [3]	16	6	−10
Nitrate (as N)	0.9mg/1-nutrient [4]	12	24	+12
Nitrite plus nitrate	0.9mg/1-nutrient [4]	18	26	+8
Total phosphorus	0.1mg/1-nutrient [2]	34	57	+23
Total phosphate	0.3mg/1-nutrient [2]	30	41	+11
Dissolved phosphate	0.3mg/l-nutrient [2]	11	22	+11
Dissolved solids (105°C)	500mg/1-water supply [2]	25	18	−7
Dissolved solids (180°C)	500mg/1-water supply [2]	28	12	−16
Chlorides	250mg/1-water supply [3]	12	9	−3
Sulfates	250mg/1-water supply [3]	12	12	0
pH	6.0–9.0-aquatic life [2]	0	0	0
Dissolved oxygen	4.0mg/1-aquatic life [2]	0	0	0
Total coliforms(MFD) [5]	10,000/100ml-recreation [2]	24	13	−11
Total coliforms(MFI) [5]	10,000/100ml-recreation [2]	50	30	−20
Total coliforms(MPN) [5]	10,000/100ml-recreation [2]	23	20	−3
Fecal coliforms(MF) [5]	2,000/100ml-recreation [2]	45	21	−24
Fecal coliforms(MPN) [5]	2,000/100ml-recreation	17	43	+26
Phenols	0.001mg/1-water supply [3]	86	71	−15

[1] Levels associated with water quality protection for each parameter and type of water use.
[2] *Guidelines for Developing or Revising Water Quality Standards*, EPA Water Planning Division, April 1973.
[3] *Criteria for Water Quality*, EPA, 1973 (Section 304(a)(1) guidelines).
[4] *Biological Associated Problems in Freshwater Environments*, FWPCA, 1966, pp. 132–33.
[5] Membrane filter delayed, membrane filter immediate, most probable number, membrane filter.

Source: Environmental Protection Agency, *National Water Quality Inventory: Report to Congress*, (1974).

Footnotes

1. The term "developed countries" is used here to refer to those which have had substantial economic growth. "Developing countries" refers to those which have not yet achieved such growth.
2. *Report of the Symposium on Population Resources and Environment* (Stockholm, 26 September–5 October 1973) for the United Nations World Population Conference, E/CONF/60/CPB/3 (March 25, 1974), pp. 8–9.
3. Population Reference Bureau, 1973 World Population Data Sheet (Washington: The Bureau, 1974).
4. UN Department of Economic and Social Affairs, *The Determinants and Consequences of Population Trends*, Population Studies No. 50 (1973), Vol. I, pp. 118–26.

5. UN Population Commission, *Preliminary Version of Concise Report on World Population Situation,* Report E/CN.9/IIISS/CRP.1 (14 February 1974), p. 13.
6. UN World Population Conference, *Recent Population Trends and Future Prospects,* Report E/CONF/60.3 (1974), pp. 66–73.
7. Walter H. Pawley, "In the Year 2000," *Ceres,* July–August 1971, reprinted in *Ceres-FAO Review on Development, World Population Year* (1974), p. 24.
8. Unless otherwise indicated, data in this section are from UN World Population Conference, *Recent Population Trends and Future Prospects,* Report E/CONF.60/3 (1974), pp. 66–73 and Table 2.
9. UN World Population Conference, *Population and the Family,* Report E/CONF.60/6 (1974), p. 38.
10. Lester R. Brown, *In the Human Interest,* Aspen Institute for Humanistic Studies, Overseas Development Council (1974), pp. 29, 43–45, and 55.
11. Data on food production in this section from UN World Population Conference, *Population Resources and the Environment,* Report E/CONF.60/5 (1974), pp. 12–22.
12. Ben J. Wattenberg, *The Demography of the 1970's: The Birth Dearth and What It Means,* prepared for *Family Circle* (1971).
13. U.S. Bureau of the Census, *Population Estimates and Projections,* Series P–25, No. 521 (May 1974).
14. National Center for Health Statistics, *Monthly Vital Statistics Report: Births, Marriages, Divorces, and Deaths for 1973* (February 28, 1974).
15. U.S. Bureau of the Census, *Projections of the Population by Age and Sex: 1972 to 2020,* Series P–25, No. 492 (December 1972).
16. International Planned Parenthood Federation, *Survey of Unmet Needs of 209 Countries,* (New York, 1973), Table 2.
17. Unpublished UN Population Commission reports and U.S. State Department analyses.
18. *Population Bulletin,* November 1959.
19. U.S. Agency for International Development, Bureau of Population and Humanitarian Assistance, Office of Population, *Population Program Assistance,* country sections (December 1972).
20. *Ibid.*
21. *The China Quarterly,* January/March 1974, pp. 40ff.
22. *Population Dynamics Quarterly,* Winter 1974, p. 1.
23. See note 19 *supra.*
24. *People,* October 1973, p. 3.
25. Robert Parke, "Toward a Population Policy for the USA: The Work of the National Commission on Population Growth and the American Future," presented to the joint meeting of the American Association for the Advancement of Science and the Consejo Nacional de Ciencia y Tecnologica, Mexico City, June 20–July 4, 1973.
26. *Science,* 4 September 1970, pp. 941ff.
27. CEQ, *Third Annual Report* (Washington, D.C.: U.S. Government Printing Office, 1972), p. 6.
28. EPA, *The National Air Monitoring Program: Air Quality and Emissions Trends, Annual Report,* EPA–4501/1–73–001a and EPA–450/1–73–001b (Research Triangle Park, N.C.; August 1973).
29. EPA, *Monitoring and Air Quality Trends Report, 1972,* EPA–450/1–73–004 (Research Triangle Park, N.C.: December 1973).
30. D. F. S. Natusch, J. R. Wallace, and C. A. Evans, "Toxic Trace Elements: Preferential Concentration in Respirable Particles," *Science,* 183:202–204 (1974).
31. Sheldon K. Friedlander, "Small Particles in Air Pose a Big Control Problem," *Environmental Science and Technology,* Vol. 7 (December 1973), p. 1117.

32. Midwest Research Institute, "Particulate Pollutant Systems Study," Vol. II, "Fine Particles Emissions," (Chicago: The Institute, 1971).
33. Friedlander, *supra* note 31.
34. EPA, "Health Consequences of Sulfur Oxide: A Report from CHESS, 1970–71," Research Triangle Park, N.C. (draft) and EPA, *supra* note 29.
35. David S. Shearer, Director, Quality Assurance and Environmental Monitoring Laboratory, National Environmental Research Center, Memo to Director, NERC, "Fine Particulate Sulfates and Nitrates: Urban Levels and Evidences of Regional Deterioration," September 19, 1973.
36. John F. Finklea, M.D., "The Health Basis for Ambient Air Quality Standards," October 29, 1973.
37. T. H. Maugh, "Carbon Monoxide: Natural Sources Dwarf Man's Output," *Science,* 177:338–9 (1972).
38. *Ibid.*
39. Letter from Robert A. Law, Environmental Protection Administration, New York, N.Y. to J. J. Reisa, March 1974.
40. Letter from Robert E. Nelligan, Director, Monitoring and Analysis Division, Office of Air Quality, Environmental Protection Agency, Research Triangle Park, N.C. to J. J. Reisa, May 1974.
41. *Ibid.*
42. The 12-month moving average is a technique employed to facilitate the observation of trends in data which show considerable short-term fluctuations. Data for each month are averaged with data from each of the preceding 11 months.
43. Unpublished data from Philadelphia Air Management Services, May 1974.
44. See note 40 *supra.*
45. John F. Finklea, M.D., "Conceptual Basis for Establishing Standards," Research Triangle Park, N.C., undated, and note 36, *supra.*
46. EPA, *National Water Quality Inventory, Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1974).
47. A. F. Bartsch, EPA–R3–72–001, National Environmental Research Center (Research Triangle Park, N.C.: 1972).
48. Division of Water Pollution Control, Indiana State Board of Health, *Preliminary Report of Phosphorus Trends at Municipal Sewage Treatment Plants and in Indiana Streams for Years 1971, 1972, and 1973* (Indianapolis, 1974).
49. R. A. Sweeny, *Impact of Detergent Phosphate Reductions on Water Quality: Report to EPA,* Great Lakes Laboratory, State University College at Buffalo, N.Y. (Buffalo: The Laboratory, 1973). See also L. Hetting and I. Carcich, *Phosphorus in Wastewater,* New York State Department of Environmental Conservation, Technical Paper #22 (Albany: The Department, 1972).
50. A third, non-quantitative technique suitable for indicating short to medium range (2 to 5 years) pollution problems was also developed for EPA during the past year. The technique, described in EPA Report No. 60015–74–005 (James E. Flinn and Robert S. Reiners, *Development of Predictions of Future Pollution Problems,* 1974) involves examining technical production activities, environmental quality factors, and socio-economic changes and/or trends to identify significant problems. Ranking factors were applied and combined with human judgment to select significant areas so that probable environmental consequences of not taking action could be projected. The application of this methodology yielded: (1) a set of 10 ranked problem areas and projections; (2) a test application of ranking factors; and (3) a list of specific stressors and their distribution among problem areas. This technique appears to be a promising complement to the two computerized models discussed in this section.

51. The model projects pollutants generated by the economic activities which have been identified as major sources of pollution. It does not include natural pollution sources or, at this time, non-point pollution sources.
52. INFORUM was developed by Professor Clopper Almon, Jr. at the University of Maryland. See Clopper Almon, Jr., et al., *1985: Interindustry Forecasts of the American Economy* (Lexington, Mass.: Lexington Books, 1974).
53. "Controlled" in this case means that all the goals established for 1977 (except those relating to NO_x) will be met by their scheduled date, and that abatement will occur at a constant rate from the enactment of the legislation up to that date. For NO_x, the model assumes no future abatement from mobile sources.

    It is important to recognize that the accuracy and comprehensiveness of SEAS in projecting the generation of pollutants are limited by the available data. In general, SEAS incorporates the best estimates of pollution coefficients, abatement costs, etc. that were available at the time of its development. However, in many cases even these best estimates are severely limited. For instance, because data are unavailable, only the most important polluting sectors are analyzed in estimating environmental residuals, and the 1983 requirements of "best available technology" established by the 1972 Amendments to the Federal Water Pollution Control Act are only partially reflected in the analysis even though the projections are carried to 1985. The value of SEAS will depend, of course, on the extent to which it incorporates additional and improved data as they become available.
54. Major sources of hydrocarbons are the drying of paint and emissions from gasoline stations, both of which are included in the industrial sector.
55. The geographical allocation is based on each region's share (using OBERS projections) of the total economic activity of each of the pollution sectors. It does not, at this time adjust for different regional emission rates or abatement levels.
56. The extraction stage includes removing the fuel from the ground and getting it to American soil (if it is imported); the transportation stage includes all stages of transportation and distribution of the energy including marketing and storage; the processing stage includes oil refining and coal washing (the liquefaction and regasification of imported natural gas is included in the extraction stages); the conversion stage includes the generation of electricity from a coal-fired electrical generating plant; and the end use stage includes the use of the energy for space heating or to power an automobile.
57. None of these figures includes the energy embodied in the capital equipment required for the system.
58. The specific energy conservation measures included were:

    1. Residential: Better insulation, new and existing housing; shift to gas and petroleum for space heat in new houses; and total energy systems in multifamily dwelling units.

    2. Commercial: Better insulation in new and existing commercial buildings and total energy systems.

    3. Industrial Energy Use: Improved energy utilization measures (e.g., closed steam traps, heat exchangers) and increased recycling.

    4. Transportation: Lighter autos; increased use of public transit and car pools; substituting trains and buses for private autos on short-haul intercity transportation; shifting freight from trucks to trains for long hauls.
59. Data in this section are taken largely from U.S. Department of the Interior, *Mining and Minerals Policies, 1973* (Washington, D.C.: U.S. Government Printing Office, 1973), pp. 18–26.

60. Midwest Research Institute, "Production, Distribution, Use, and Environmental Impact Potential of Selected Pesticidies," report prepared for the Council on Environmental Quality, 1974.
61. U.S. Department of Agriculture, *Quantities of Pesticides Used by Farmers in 1966,* Agricultural Economic Report No. 179 (Washington, D.C.: U.S. Government Printing Office, 1970); and U.S. Department of Agriculture, Economic Research Service, *Quantities of Pesticides Used by Farmers in 1971* (Washington, D.C.: U.S. Government Printing Office, 1974).
62. See D. W. Jenkins et al., "Development of a Continuing Program to Provide Indicators and Indices of Wildlife and the Natural Environment," Smithsonian Institution Ecology Program, Final Report to CEQ (1972); National Aeronautics and Space Administration, "Report on 1973 Santa Cruz Summer Study of Wildlife Resources Monitoring" (1973); Lee M. Talbot, "Non-Game Wildlife: A Federal Perspective," address at the North American Wildlife and Natural Resources Conference, Denver, April 1974; and *Ecological Programs in the Federal Government,* Report of the Committee on Ecological Sciences, CEQ-Federal Council on Science and Technology, 1974.
63. Information supplied by Lynn Greenwalt, Director, U.S. Fish and Wildlife Service, March 1974.
64. C. Halvorson, J. Linduska, and A. Stabler, *Economic Values of Wildlife Production in Forestry Areas in North America,* Bureau of Sport Fisheries, U.S. Department of the Interior (Washington, D.C.: U.S. Government Printing Office, 1972).
65. U.S. Department of the Interior, National Survey of Fishing and Hunting, 1970, and 1971.
66. J. C. Horvath, *Preliminary Economic Survey of Southeastern Wildlife; Executive Summary,* Environmental Research Group, Georgia State University (Atlanta: The University, 1973).
67. Information supplied by M. J. Imlay, Fish and Wildlife Service, U.S. Department of the Interior, April 1974.
68. Bureau of Sports Fisheries and Wildlife, U.S. Department of the Interior, "Final Environmental Statement for the Proposed Endangered Species Conservation Act of 1973 (H.R. 4758)," August 7, 1973.
69. Jenkins et al., *supra* note 62.
70. CEQ, *Third Annual Report* (Washington, D.C.: U.S. Government Printing Office, 1972), pp. 27–28.
71. Information supplied by C. S. Robbins, Chief, Migratory Non-Game Bird Studies, Migratory Bird and Habitat Research Laboratory, Fish and Wildlife Service, Laurel, Maryland, March 1974.
72. Jenkins et al., *supra* note 72.
73. National Aeronautics and Space Administration, *supra* note 62.
74. National Environmental Policy Act, P.L. 91–190, section 102(2)B.
75. Library of Congress, Congressional Research Service, Environmental Policy Division, *Environmental Indices, Status of Development Pursuant to Sections 102(2)(B) and 204 of the National Environmental Policy Act of 1969,* report prepared for the Committee on Interior and Insular Affairs, December 1973; and National Academy of Sciences, Environmental Studies Board, "Planning for Environmental Quality Indices" (in preparation, 1974).
76. EPA, Office of Air Programs, *The Selection of Air Quality Indices,* report prepared by Technology Service Corporation, August 16, 1973.
77. W. D. Schults and J. J. Beauchamps, *The Development of Air Quality Indices,* Oak Ridge National Laboratory, ARNL–NSF–EP–56, July 1973.
78. *Supra* note 75.
79. *Ibid.*

CHAPTER 4

The National Environmental Policy Act

"The public interest requires doing today those things that men of intelligence and good will would wish, five or ten years hence, had been done," declared Edmund Burke nearly two centuries ago. At the turn of this decade, in pursuit of the public interest, Congress passed the National Environmental Policy Act [1]—a comprehensive national policy for restoring, protecting, and enhancing the quality of our environment.

In NEPA, Congress declared that "each person should enjoy a healthful environment, and . . . each person has the responsibility to contribute to the preservation and enhancement of the environment." Congress also authorized and directed that "to the fullest extent possible . . . the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act." And focusing on the decisionmaking processes of Federal departments and agencies, Congress ordered that agencies prepare an environmental impact statement in connection with every major action which significantly affects the environment. Congress further ordered that this environmental analysis accompany the corresponding proposal through the agency's decisionmaking process and that agency officials carefully consider it at each stage. In passing the law, Congress demanded no less than a major new way of thinking and acting by the executive agencies of the Federal Government.

Nearly 5 years have passed since NEPA was enacted. Two years ago, in our Third Annual Report, we reviewed the initial impact of the law and discussed the process of change which it had initiated.[2] Evolution has continued during the ensuing period. Overall, what began as a sharp departure from previous practice has become with

time an increasingly accepted and integral part of the Federal decisionmaking process. To a significant (if still incomplete) degree, NEPA has succeeded in its objective of incorporating an environmental perspective into the decisionmaking process of Federal agencies. Beyond that, the approaches of NEPA have spread beyond the Federal Government and have been adopted by state and local governments and even by other nations.

This chapter updates and expands on the perspective presented in the Council's Third Annual Report. The first section looks back over the last 5 years at the process by which Federal agencies adapted their activities to the law. The next sections cover significant events during the past year in administration of the law and in judicial interpretation of its requirements. Next discussed are the development of state NEPA's and the adoption of the impact statement process by foreign countries. The chapter concludes with some thoughts on what the future may hold for the environmental impact statement process.

Evolution of NEPA—The First Five Years

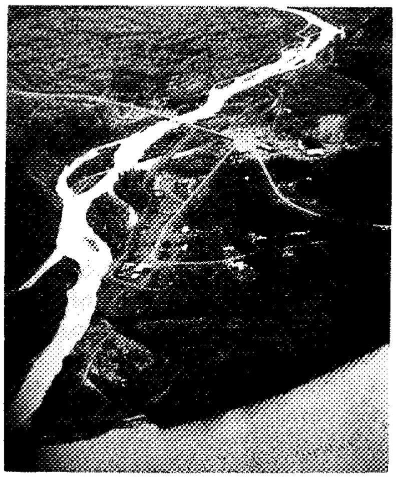
When the first 5 years of NEPA are examined, three broad stages of development are evident: an initial period, during which Federal agencies became aware of the Act; a transition period, in which agencies came to understand and adapt to its requirements; and the present period, in which NEPA is increasingly being integrated into the fabric of agencies' programs.

Development of Awareness—1969–70

The first stage in the development of NEPA began in the spring of 1969 and lasted about a year. During consideration of the bill that ultimately became NEPA, Congress saw a need to modify Federal administrative practice so as to encourage the development and use of environmental analysis in agency decisionmaking. On April 16, 1969, it was first suggested that an "action forcing mechanism" be inserted that would prod agencies to pay heed to the policies and goals of the Act.[3] This suggestion led to the requirement that agencies prepare environmental impact statements on their major actions that significantly affect the environment.

NEPA was signed by the President on January 1, 1970. Initially, the agencies were generally unaware of the requirements of the Act. When the requirements were pointed out, most agencies adopted the position that NEPA did not apply to them at all—at least not to most of their programs—or, if it did apply, an impact statement could be prepared by their administrative staff as a finishing touch when the project went forward for final agency approval.

This first stage ended in April 1970 with the initial major court



One of the first major court cases involving NEPA concerned the Trans-Alaska pipeline. Photo shows where the pipeline will cross the Klutina River, which drains into the Copper River, a prime route for salmon to reach spawning sites.

decision under the Act—the Trans-Alaska Pipeline case.[4] In this case, the court determined that the Secretary of the Interior could not grant permits for the construction of a road to be used in connection with construction of the pipeline, until he had met the requirements of NEPA. The decision gave reality and importance to NEPA, and it focused attention within agencies on the specific requirements of section 102(2)(C) of the Act.

The Transition Period—1970–73

The transition period began in the spring of 1970 and lasted approximately 3 years. During this period agencies came to grips with the fact that NEPA had to become a regular part of their activities. At first, many agencies attempted to comply with the Act on an ad hoc basis. Frequently, an agency would decide to prepare an impact statement only when challenged by the public for its failure to do so. The period was marked with uncertainty and, in some cases, disruption.

A number of basic questions surfaced during this period. What was meant by the concept "major Federal action significantly affecting the environment"? When in the development of a project must an environmental impact statement be prepared? What must the impact statement contain? How were environmental consequences to be forecast?

To assist agencies in developing answers, CEQ issued three sets of instructions. In April 1971, CEQ's interim guidelines (issued a year earlier) were revised to provide expanded guidance on the timing of the preparation of a statement and its use in the agency's decision process.[5] In May 1972, CEQ issued a set of recommendations on the contents of statements and on procedures for their

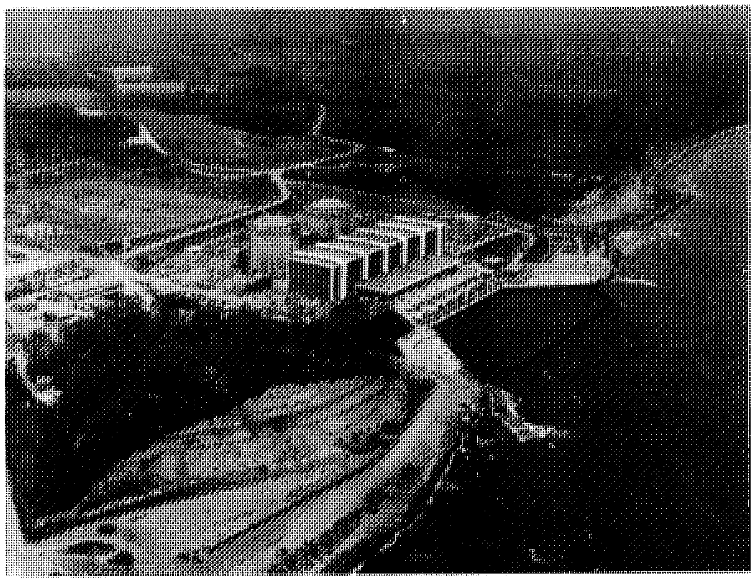
preparation and circulation to other agencies and the public.[6] In August 1973, CEQ issued a further revision of its guidelines, establishing a detailed structure and comprehensive set of policies for the overall operation of the process.[7] These three sets of directives built on the rapidly expanding base of agency experience and codified the major court decisions that were being handed down. By the summer of 1973, with these instructions in hand, most of the early uncertainty over NEPA's requirements had been resolved.

Experience of the AEC—The experiences of agencies during this transition period varied widely. Nonetheless, to understand the difficulties of the transition, it is useful to focus on how one agency wrestled with the requirements of the Act.

Under the Atomic Energy Act of 1954,[8] the Atomic Energy Commission was given the regulatory responsibility to insure that peaceful uses of atomic energy do not result in undue risks to public health and safety. With regard to nuclear power plants, a comprehensive licensing process was established under which applicants were required to obtain first a permit to construct a plant and then a license to operate it.[9]

At the time NEPA was enacted, an applicant for a construction permit was required to submit a detailed technical study of the proposed site, the design of the facility, and the operating procedures which would be followed. After technical review by the AEC's regulatory staff, this application was submitted to the Advisory Committee on Reactor Safeguards (ACRS), a special group of experts established by Congress to advise the Commission on nuclear safety matters. After a mandatory hearing in which the public was invited to participate, an initial decision was issued by the Advisory Committee, which was then subject to review by the Atomic Safety and Licensing Appeal Board or by the Commission itself. Finally, when an application for the operating license was filed, normally about 2 years later, the regulatory staff and the ACRS again conducted a comprehensive safety review.[10] If there was sufficient public interest, a hearing was held.

After enactment of NEPA, the AEC determined that the licensing of nuclear power plants was a "major Federal action significantly affecting the quality of the environment" and that an impact statement was required. At the same time, AEC made an initial policy decision to implement NEPA within the framework of its ongoing regulatory program and to emphasize in the statement the radiological impact of the proposed facility. With regard to other environmental impacts, such as the thermal effects of the discharge of power plant cooling water, the AEC determined to accept certification of state or regional water quality agencies as adequate evidence that there would not be an adverse effect on the environment. AEC also made the decision to undertake environmental analysis only on new applications, determining that no environmental issues could



The proposed licensing of the Calvert Cliffs nuclear power plant sparked major concern about AEC's review of nuclear facilities. Picture shows the plant during the final stages of construction.

be raised at hearings on nuclear power plants noticed prior to March 1971. In short, the AEC initially determined that its NEPA analysis would be initiated prospectively for new power plants coming forward for licensing, and that its analysis would concentrate primarily on issues relating to radiation.[11]

Calvert Cliffs'—In July 1971, in one of the major NEPA decisions, the U.S. Court of Appeals for the District of Columbia ruled in the *Calvert Cliffs'* case that the AEC procedures were unacceptable.[12] The court declared that the AEC must undertake an independent evaluation and balancing of a variety of environmental factors, such as thermal effects, notwithstanding the fact that other Federal or state agencies had certified that their own environmental requirements would be satisfied. In each case, the benefits of the licensing action were to be assessed and weighed against the environmental costs, and alternatives were to be considered that would affect the balancing of values.

The decision also made clear that the Act was not to be read as requiring only an impact statement that might be properly prepared but later ignored. The court noted that the Act also mandates a careful and informed decisionmaking process. Environmental information was to be sought, reported, and, most importantly, used in making agency decisions.

The decision further required that contested as well as uncontested proceedings must undergo an independent substantive review of environmental matters, and that environmental issues must be considered in connection with all nuclear power reactor licensing decisions which took place after January 1, 1970, the effective date of NEPA. The court also required a NEPA review for construction permits issued prior to January 1, 1970, in cases where an operating license had not yet been issued.

Thus the decision in *Calvert Cliffs'* significantly broadened the range of issues which the AEC was required to consider in discharging its NEPA responsibilities. It also directed that this analysis be undertaken for many nuclear power plants initiated prior to the enactment of NEPA.

In August 1971, the AEC announced that it would not appeal the decision but would accept the judicial mandate and address NEPA responsibilities as defined by the court. In making the announcement, the Chairman of the AEC stated that

> [T]he effect of our revised regulations will be to make the Atomic Energy Commission directly responsible for evaluating the total environmental impact, including thermal effect of nuclear power plants, and for assessing this impact in terms of the available alternatives in the need for electric power. We intend to be in a position to be responsive to the concerns of conservation and environmental groups as well as other members of the public. At the same time, we are also examining steps that can be taken to reconcile a proper regard for the environment with the necessity of meeting the nation's growing requirements for electric power on a timely basis.[13]

Impact of Calvert Cliffs'—The impact of the *Calvert Cliffs'* decision on the licensing and regulatory functions of the AEC was immediate and far-reaching. The broadened regulatory responsibilities required development of new technical expertise in the AEC as well as in industrial organizations, and it necessitated the development of new technical and cost-benefit analysis concepts. Further, the *Calvert Cliffs'* decision required the development of new procedural processes to provide for the participation of the applicant, other agencies, and the public in the environmental review process.

As an immediate problem, the *Calvert Cliffs'* decision resulted in a backlog of 110 nuclear power plants and 10 nuclear facilities requiring expanded or new environmental reviews. Whereas previously the AEC had devoted about one-half a man-year per case for NEPA review, after *Calvert Cliffs'* it invested 2 to 5 man-years for each application. Fortunately, the AEC had previously been involved in environmental research because of its environmental protection responsibilities with respect to nuclear material; hence the agency was able to draw on well-experienced people among its own employees and at three of its laboratories—Argonne, Oak Ridge, and Pacific Northwest—to meet this new workload.

Its new procedure involved, for each environmental report received from an applicant, the formation of a review team, consisting

of members of the regulatory staff and environmental scientists from the laboratories. These teams included specialists in the major scientific and engineering disciplines involved in evaluating environmental impact, normally ecology, hydrology, biology, radiation, health physics, meteorology, and chemical, mechanical, civil, and nuclear engineering. A single team, after reviewing the reports, undertook field and library research and wrote the impact statement, using all available information. If additional field data were required, the team recommended to the applicant that it produce them. In addition, the organization of regulatory personnel in Washington was altered. Within 4 months of the *Calvert Cliffs'* decision, about 200 people were involved in environmental review efforts.[14]

In order to facilitate the new environmental reviews, the AEC developed a series of guides for industry which defined the information necessary for evaluating environmental impacts. One of the series was the guide for preparation of environmental reports for nuclear power plants.[15] This guide specified for the license applicant the kinds of information required in the preparation of his environmental report, including: (1) the site and reactor characteristics; (2) power needs in the area; (3) the environmental effects of site preparation; (4) plant and transmission facilities construction; (5) the environmental effects of plant operation; (6) effluent and environmental measurements and monitoring; (7) the environmental effects of accidents; (8) the economic and social effects of plant construction and operation; (9) alternative energy sources and sites; and (10) plant design alternatives.

An objective of the guide was to assure that the applicants would provide all of the required data in the first submission of the report and thus avoid uncertainties and time-consuming delays. The applicant's environmental report was required to demonstrate, through the cost-benefit analysis of the proposed plant, how in the applicant's judgment, the aggregate benefits outweighed aggregate costs. Upon receipt of an acceptable environmental report, the AEC multidisciplinary teams would perform detailed evaluation of the potential environmental impact of the proposed nuclear power plant and the environmental cost-benefit analysis.

The AEC also adopted new approaches to public hearings. Rules, restructured for the conduct of licensing procedures, were aimed at assuring early and maximum participation of interested parties, timely availability of all relevant information, and effective and expeditious progress during the procedural steps in the hearing process.

The application of the NEPA review procedures has resulted over the past 3 years in many modifications and changes in nuclear plant design, including redesign of intake structures and major cooling systems, modifications of the thermal plume and the radiological and the chemical waste systems, rerouting of transmission lines, installation of fish screens, redesign of causeways, revision of environmental monitoring plans, and new studies of alternative cooling systems.[16]

The years 1971 to 1973 placed particular strains on the AEC. The agency had to analyze the large number of plants in the licensing pipeline as well as new applications coming before it. But by mid-1974, the backlog had been surmounted and the changes required of the AEC regulatory program had been put into effect. The initial uncertainty and disruption had been overcome.

Integration of NEPA into Agency Operations

The third stage of NEPA development began for many agencies with the promulgation of CEQ's guidelines in August 1973. With the early uncertainties about NEPA clarified, the task was to weave the policies and procedural requirements of NEPA into each agency's programs. For many agencies, this stage is not yet complete. What must ultimately emerge is a consideration of the environmental implications of an agency's activities as an integral component of the agency's normal decisionmaking process. Naturally, the experiences of agencies differ. However, the Forest Service provides an interesting example of the integration of NEPA into the fabric of an agency's operations.

The Forest Service is one of the Nation's oldest natural resource agencies. It is responsible for national leadership in forestry. Its activities include the management, protection, and development of the 187-million-acre National Forest System to produce wood, water, forage, wildlife, and recreation; and cooperation with state foresters, private owners of forest lands, wood processors, and private and public agencies in all aspects of forestry management.

When NEPA was enacted, the Forest Service saw it as supportive of the Service's conservation ethic and fully consistent with its existing responsibilities as contained in the Organic Act of 1897 and the Multiple Use-Sustained Yield Act of 1960.[17] The Forest Service also perceived procedural similarities to existing practices. For example, the Service had for some years required multiple use surveys and impact surveys similar to environmental statements before undertaking actions such as major timber harvesting contracts, although the surveys had not required either formalized public review or a broad analysis of alternatives.

Because of these similarities, some officials of the Forest Service were tempted to view NEPA as not affecting their agency. This view did not prevail. Instead, the decision was made to implement fully the new law. A year after the passage of the Act, the Chief of the Forest Service said: "We are going through a period of interpreting the requirements of the Act. During this period, we must lean over backward to comply with both the letter and the spirit of this law and we must do our best to learn how to work with it. . . ."[18]

As a first step, the Forest Service integrated the mandates of

NEPA into its formal statement of objectives and policy. *Framework for the Future,* issued in early 1970,[19] including protection and improvement of the quality of air, water, soil, of natural beauty, and of open space, among the agency's major objectives.

The Forest Service then developed instructions for implementing the impact statement requirements. The agency discovered that it could not develop a simple definition of major actions requiring a statement; therefore, a case-by-case evaluation of proposed actions against several criteria was required. With experience, the Forest Service was later able to identify certain activities that almost always require an impact statment, among them land use plans, new winter sports sites, major pesticide programs, and activities in roadless areas.

In 1971, the Forest Service issued detailed procedural instructions to its field offices on preparing and processing impact statements.[20] Since it is essential that environmental factors be considered early in planning and decisionmaking, the Forest Service decided to integrate the preparation of impact statements into its land use planning process. Late in 1971, the multiple use and land use planning system was completely revised in order to merge it with the requirements of NEPA.[21] Later, on the basis of an interdisciplinary study, the Forest Service adopted a "unified planning and decisionmaking concept" (UPD),[22] which changed the planning approach for the use of a forest area. In the past, decisions governing the use of an area for activities such as timber harvesting, grazing, mining, and recreation had been made more or less independently. Under UPD, decisions governing these different uses of an area were made together. NEPA was a major factor in the development of this integrated approach.

Setting policy was not the same as implementing it. The process of adapting to the new requirements and procedures took time because it affected the efforts of many Forest Service personnel. Since the Forest Service is highly decentralized, the responsibility for preparing impact statements was delegated to its field offices. Moreover, the effect of Forest Service policies was to require some form of environmental analysis on virtually all actions. For all major actions, an environmental impact statement (EIS) was prepared; for minor actions, environmental analysis covering the same major points as an EIS served as primary documentation for decisions and actions.

As a result, the Forest Service policies and procedures required a very large number of Forest Service personnel to become involved in NEPA, not as a separate function or activity but as an integral part of planning and decisionmaking. Thus, rather than creating a separate organizational structure for NEPA, an Environmental Coordinator in Washington with only a small staff was assigned oversight, coordination, and leadership responsibility for NEPA. After this approach proved successful, similar positions were designated in the field.

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NEPA also brought about major changes in the ways in which the Forest Service related to the public. Prior to NEPA, the public, especially the local public, were "informed" of Forest Service decisions. Rarely were they meaningfully involved in decisionmaking. Although some personnel are still reluctant to involve the public, the Forest Service has made major changes since NEPA in its attitudes and practices. Different forms of public participation are now used, depending on the situation and the stage of planning. In local areas, citizens are now invited early in a planning process to provide ideas and help identify issues and alternatives. Incorporation of NEPA public involvement requirements has broadened the "public" which is involved, making it possible for interested citizens to participate in decisions on projects proposed for any part of the country. Coupled with the requirement under NEPA to analyze alternatives to a proposal, this arrangement has resulted in the consideration of a much wider range of possible uses for a forest area than had occurred in the past.

The new approach to the environment has created more than procedural and administrative changes. It has also stimulated substantive review of Forest Service management practices, especially timber management.[23] Since the passage of NEPA, a number of studies have examined timber cutting practices from a long-term environmental perspective. The Forest Service itself has undertaken studies of the Bitterroot National Forest, the Monongahela National Forest, the Wyoming National Forests, as well as a nationwide survey of National Forest timber management.[24] Major reviews by authorities outside the Forest Service have included a study of clearcutting by the deans of five forestry schools, an investigation of clearcutting on public lands by a Senate subcommittee, an investigation by the West Virginia legislature of timber harvesting in the Monongahela National Forest, and a study of management practices of the Bitterroot National Forest in Montana by a team of scientists from the University of Montana.

In addition to timber management, other Forest Service responsibilities were affected by NEPA. In 1970, a comprehensive national survey of range ecosystems was initiated. This survey, completed in 1972, provides new guidance for the most productive and environmentally sound management of range lands. In 1974, the Service proposed the first regulations to control indiscriminate and damaging mineral prospecting and development activities on National Forest lands.

Because of the nature of its activities, the Forest Service recognized the value and need for program impact statements as early as 1971. Statements have been prepared on a variety of activities, including timber management, vegetation management, and pesticide use. One of the most complex program statements involved the review of National Forest roadless areas.

At the broadest level, an environmental analysis of all Forest Ser-

vice activities is currently being prepared. Called "The Environmental Program for the Future," this study is examining public needs and demands on the National Forests and defining alternatives for accomplishing objectives. It is the most ambitious comprehensive effort that the Forest Service has yet attempted.

In conclusion, NEPA has had a major impact on the Forest Service. The agency took a broad and positive view toward implementation of the Act, went far beyond a narrow concern with the Section 102 requirement, and integrated each step in the NEPA process—from initial environmental analysis through preparation of draft environmental statements, involvement of the public, analysis of comments, and preparation of final statements—into the planning and decisionmaking process. This is not to say that all difficulties have been resolved. Legal action is pending on several issues, and the quality of land use plans and impact statements can still be improved. Nonetheless, the overall picture is extremely encouraging in terms of the integration of NEPA into the fabric of the agency's operations.

Administrative Developments—1973–74

Agency NEPA Procedures

On August 1, 1973, CEQ issued new guidelines for the operation of the environmental impact statement process.[25] The guidelines (which are reproduced in Appendix D of this report) were discussed in detail in last year's Annual Report. They establish the basic structure and procedures governing the preparation of impact statements. They set forth the required contents of a statement and the responsibilities of parties reviewing and commenting on a draft statement. They also set forth NEPA's policies governing agencies' involvement of the public, and agencies' use of an impact statement in their decisionmaking process. Section 1500.3(a) directs agencies to review their NEPA procedures and revise them as may be necessary in order to conform to the guidelines.

During this past year, many agencies engaged in a major effort to revise their procedures for the implementation of NEPA. Table 1 sets forth the status of agencies' NEPA procedures, as of August 1, 1974, as well as citations to those procedures.

While an agency's NEPA procedures are important, they form only the skeleton for the operation of the agency's environmental impact statement process. Of greater importance is an understanding by agency staff of the purpose and goals behind NEPA and of methods for making environmental analyses and assessing the significance of the results generated. The past year saw major progress in this direction. Simultaneous with the development of new NEPA procedures, agencies conducted numerous training sessions, work-

Table 1
Agency NEPA Procedures, as of August 1, 1974

Agency	Current procedures		Proposed revisions (if any)	
	Date	Citation [1]	Date	Citation [1]
Department of Agriculture				
Departmental	May 29, 1974	39 F.R. 18678		
Agriculture Stabilization and Conservation Service	May 29, 1974	39 F.R. 18678	May 31, 1974	39 F.R. 20490
Animal and Plant Health Inspection Service	Jan. 29, 1974[2]	39 F.R. 3696 [2]		
Farmers Home Administration	Aug. 29, 1972	37 F.R. 17459		
Forest Service	May 3, 1973	38 F.R. 20919	Nov. 19,1973	38 F.R. 31922
Rural Electrification Administration	May 20, 1974	39 F.R. 23240		
Soil Conservation Service	June 3, 1974	7 C.F.R. Part 650 39 F.R. 19646		
Appalachian Regional Commission	June 7, 1971	36 F.R. 23676		
Atomic Energy Commission				
Regulatory	July 18, 1974	10 C.F.R. Part 51 39 F.R. 26279		
Non-Regulatory	Feb. 14, 1974	10 C.F.R. Part 11 39 F.R. 5620		
Canal Zone Government	Oct. 20, 1972	37 F.R. 22669		
Central Intelligence Agency	Jan. 28, 1974	39 F.R. 3579		
Civil Aeronautics Board	July 1, 1971	14 C.F.R. §399.110 36 F.R. 12513	May 24, 1974	39 F.R. 18288
Department of Commerce	Oct. 23, 1971	36 F.R. 21368	Dec. 6, 1973	38 F.R. 33625
Department of Defense	Apr. 26, 1974	32 C.F.R. Part 214 39 F.R. 14699		
Corps of Engineers	Apr. 8, 1974	33 C.F.R. §209.410 39 F.R. 12737		
Delaware River Basin Commission	July 11, 1974	18 C.F.R. Part 401 39 F.R. 25473		

Environmental Protection Agency	Jan. 17, 1973	40 C.F.R. Part 6 38 F.R. 1696	July 17, 1974	93 F.R. 26253
Federal Communications Commission	July 24, 1972	37 F.R. 15711		
Federal Power Commission	Dec. 18, 1972	Commission Order No. 415–C 37 F.R. 28412		
Federal Trade Commission	Nov. 19, 1971	16 C.F.R. §1.81–1.85 36 F.R. 22814		
General Services Administration			Apr. 16, 1974	GSA Order ADM 1095 39 F.R. 13722
Federal Supply Service	Dec. 11, 1971	FSS 1095.1A 36 F.R. 23702		
Transportation and Communications Service	June 30, 1971	TCS 1095.1		
Property Management and Disposal Service	Dec. 30, 1971	PMD Order 1095.1A 36 F.R. 23704		
Public Buildings Service	Mar. 2, 1973	PBS Order 1095.1B		
Department of Health, Education and Welfare				
Departmental	Oct. 17, 1973	HEW General Administration Manual—Chapters 30–10 through 30–16		
Food and Drug Administration	Mar. 15, 1973	21 C.F.R. Parts 6,601 38 F.R. 7001	Apr. 16, 1974	39 F.R. 13741
Department of Housing and Urban Development	July 18, 1973	38 F.R. 19182	Feb. 22, 1974	39 F.R. 6815
Department of the Interior				
Departmental	Sept. 27, 1971	36 F.R. 19343		
Bonneville Power Administration	Jan. 19, 1972	37 F.R. 815		
Bureau of Indian Affairs	Sept. 17, 1970	Departmental Manual Release		
Bureau of Land Management	July 31, 1974	Departmental Manual Release		
Bureau of Mines	Feb. 9, 1972	37 F.R. 2895		
Bureau of Outdoor Recreation	Mar. 24, 1972	37 F.R. 6501		
Bureau of Reclamation	Jan. 18, 1972	37 F.R. 1126		
U.S. Fish and Wildlife Service	Dec. 1971	37 F.R. 207		
Geological Survey	Mar. 11, 1972	37 F.R. 5263		
National Park Service	July 29, 1974	Internal National Park Service Manual		

See footnotes at end of table.

Agency NEPA Procedures, As Of August 1, 1974—Continued

Agencv	Current procedures		Proposed revisions (if any)	
	Date	Citation [1]	Date	Citation [1]
Interstate Commerce Commission	Mar. 28, 1972	49 C.F.R. § 1100.250 37 F.R. 6318		
Department of Justice (Law Enforcement Assistance Administration)	Feb. 6, 1974	28 C.F.R. Part 19 39 F.R. 4736		
Department of Labor	Mar. 15, 1974	29 C.F.R. Part 1999 39 F.R. 9959		
National Aeronautics and Space Administration	Apr. 10, 1974	14 C.F.R. § 1204.11 39 F.R. 12999		
National Capital Planning Commission	Aug. 1972	37 F.R. 16039		
National Science Foundation	Jan. 28, 1974	45 C.F.R. Part 640 39 F.R. 3544		
Small Business Administration	Oct. 20, 1972	37 F.R. 22697		
Department of State				
Departmental	Aug. 31, 1972	37 F.R. 19167		
International Boundary and Water Commission	Mar. 14, 1974	39 F.R. 9868		
Tennessee Valley Authority	Feb. 14, 1974	39 F.R. 5671		

Department of Transportation				
Departmental	Nov. 1, 1973	38 F.R. 30215		
Federal Aviation Administration	June 19, 1973	FAA Order 1050.1A		
Federal Highway Administration	Sept. 7, 1972	Policy and Procedure Manual (PPM) 90–1 37 F.R. 21803	Nov. 1, 1973	38 F.R. 30192.
United States Coast Guard	Dec. 11, 1973	Commandant Instruction 5922.10A Series 38 F.R. 34135		
Urban Mass Transportation Administration	Feb. 1, 1972	DOT Order 5610.1 37 F.R. 22692		
National Highway Traffic Safety Administration	Nov. 20, 1972	DOT Order 560–1 38 F.R. 30215	Dec. 21, 1973	38 F.R. 35018
Saint Lawrence Seaway Development Corporation	Nov. 1971	Procedure SLS 2–5610.1A	Nov. 21, 1973	38 F.R. 32179
Department of the Treasury	Apr. 26, 1974	39 F.R. 14796		
Internal Revenue Service	Aug. 12, 1971	36 F.R. 15061		
Veterans Administration	June 17, 1974	39 F.R. 21016		
Water Resources Council	Feb. 10, 1971	36 F.R. 23711		

[1] Citations are given to an agency's procedures where they have been published in the *Federal Register* or otherwise formally issued.
[2] These procedures, while issued in proposed form, are currently being followed on an interim basis.

shops, and seminars for their staffs. Over 100 separate meetings were held across the United States, involving a total of several thousand agency personnel. These meetings were aimed at explaining the basic tools and understanding necessary to integrate the spirit of the impact statement process into an agency's operations.

Studies of NEPA

During this past year, several studies were completed or initiated on selected aspects of the impact statement process. These efforts were directed at agency implementation of the NEPA process, at selected case studies, and at the development of better methodologies for predicting the environmental consequences of different actions.

NEPA Process Studies—At the beginning of the year, CEQ commissioned separate in-depth studies of the impact of NEPA on the decisionmaking processes of the Forest Service, the Bureau of Land Management (BLM), and the Department of the Navy.[26] These studies emphasized the relationship between the agencies' normal planning, implementation, and control procedures and the environmental impact statement process. Impediments to full implementation of NEPA were investigated.

Forest Service procedures were found to comply substantially with both the letter and spirit of NEPA and with the Council's guidelines. As noted earlier, NEPA has been merged into the Forest Service planning system to form a single integrated process. The study concluded that the quality of the land use plans and analysis could still be improved, in particular through collection of better sociological and economic information.

BLM has supplemented its planning system at critical points to fulfill NEPA's requirements and is now developing additional changes in the system to better emphasize environmental values. BLM has not generally prepared environmental statements on its management framework plans, believing that statements can be more effectively prepared on specific actions later in its decision process. The study recommended that impact statements should be prepared on these plans.

BLM's implementation of NEPA has been highly centralized. The study recommended that authority to decide whether a statement should be prepared and to approve the release of the statement be delegated to the official otherwise responsible for the proposed action. Within the BLM, NEPA has produced increased public participation in the Bureau's planning activities.

The study of the Department of the Navy illustrated the importance of the attitudes of senior agency officials. The report identified a widespread concern about the environment at the Navy's interme-

diate and lower management levels and documented substantial efforts to prevent environmental problems before they arose. The report attributed this to the interest of senior agency officials in carrying out Navy projects in a manner designed to avoid environmental damage. The report noted, however, that the degree of integration of the procedural requirements of NEPA varies from program to program, in part because of the different time frames available for the preparation of underlying documentation.

Taken together, the studies provide concrete information on the efficacy of different approaches which several agencies have taken in the establishment of their impact statement process.

NEPA Case Studies—In addition to these studies of the NEPA process, several case studies of the impact of NEPA on particular projects were completed during the year. A study of the Army Corps of Engineers' proposed Oakley reservoir in southern Illinois was compiled by Roger W. Findley at the University of Illinois.[27] A study of the Corps' New Melones reservoir in California was compiled by John Randolph at Stanford University.[28] In addition, CEQ has recently contracted for several case studies on how NEPA influenced the development of specific projects. The major objective in each instance will be to show how NEPA can, in a particular situation, help improve the design of a project. CEQ intends to publish these case studies as they become available.

Methodologies for Environmental Analysis—Section 102(2)(B) of NEPA requires that agencies identify and develop methods and procedures which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical values. At the time NEPA was passed, few methodologies existed for making environmental forecasts. That situation is changing.

The Environmental Protection Agency has begun to prepare detailed methodologies for analyzing the environmental aspects of different types of projects. During the past year, handbooks on how to analyze a highway project and how to write an impact statement for a sewage treatment plant project were prepared.[29] EPA plans during this next year to develop handbooks for water resource projects, nuclear power plants, airports, and urban transportation systems.

The Institute for Ecology (TIE), under a grant from the Ford Foundation, is also engaged in developing methodologies for analyzing the environmental effects of different types of projects. Using teams composed primarily of university faculty and graduate students, TIE has prepared detailed reviews of selected impact statements. During the coming year, TIE plans to draw on the expertise gained in these reviews to develop substantive guidelines for writing impact statements for various categories of projects.

EPA and NEPA

Although EPA traditionally applied the environmental impact statement process to its program of grants for construction of municipal sewage treatment facilities, there had been substantial uncertainty whether NEPA was meant to apply to the agency's regulatory activities.

In enacting the 1972 Amendments to the Federal Water Pollution Control Act, Congress specified that no actions of the Administrator under the Act required impact statements except grants for waste treatment facilities and permits for discharges from new sources.[30] In 1973 and 1974, several courts reviewed the application of NEPA's impact statement requirements to actions of the Administrator under the Clean Air Act [31] and the Federal Insecticide, Fungicide, and Rodenticide Act.[32] In every case, the court concluded that EPA's actions were not subject to the impact statement requirement, primarily on the ground that EPA prepares the "functional equivalent" of an impact statement in the documentation supporting its actions.[33] And in June 1974 Congress provided in the Energy Supply and Environmental Coordination Act that no action taken under the Clean Air Act shall be deemed a major Federal action significantly affecting the quality of the human environment within the meaning of NEPA.[34] As a result, it now appears that EPA is legally not required to prepare impact statements in connection with its regulatory activities.

Nonetheless, in May 1974 EPA announced that it would voluntarily prepare impact statements on a variety of regulatory actions.[35] EPA concluded that the objective of NEPA—to build into each agency a careful consideration of all environmental aspects of its proposed actions—could be beneficially applied to many of EPA's regulatory functions. Under this new policy, which became effective October 15, 1974, impact statements will be prepared in connection with such actions as the establishment of national ambient air quality standards, the designation of sites for ocean dumping, and the cancellation of a pesticide registration.

Statistics on the Impact Statement Process

By June 30, 1974, four and a half years after NEPA was enacted, environmental impact statements had been prepared on 5,430 agency actions. Final impact statements had been completed for 3,344 of these actions. Draft impact statements had been issued for the remaining 2,086 actions.

Last year's Annual Report indicated a downward trend in the annual number of impact statements being prepared. The number of new statements filed with CEQ declined from a high of 1,949 in 1971 to 1,371 in 1972 and 1,148 in 1973. However, a projection of

the figures for the first 6 months of 1974 indicates a slight increase in the number of statements likely to be filed this year. It is still too early to be certain whether this projection from the submissions in the first half of 1974 represents the beginning of a change in the downward trend of the last 3 years. Figure 1 presents the number of impact statements which have been filed annually with the Council. Figure 2 presents the number of impact statements prepared by each agency from January 1, 1970, to July 1, 1974. Figure 3 presents the number of impact statements by type of project from January 1, 1970, to July 1, 1974.

The Department of Transportation continues to file the largest number of statements. At the same time, both in absolute terms and as a proportion of the total number of statements filed by all agencies, DOT statements have decreased each year since 1971. For 1973, DOT statements numbered 432 and comprised 37 percent of all filings. For the first six months of 1974, DOT statements numbered 196 and accounted for 33 percent of all filings. Last year's Annual Report attributed this downward trend to better screening of insignificant actions by the Federal Highway Administration and the Federal Aviation Administration, and to the consolidation of numerous small highway statements into fewer, but broader, statements. These actions appear to be continuing. Even when DOT decides not to prepare a detailed statement, it still prepares a preliminary environmental analysis to support its decision on the proposed action.

The Army Corps of Engineers is second in terms of the number of

Figure 1

Environmental Impact Statements Filed Annually

Figure 2

Environmental Impact Statements Filed Annually, by Agency, to July 1, 1974

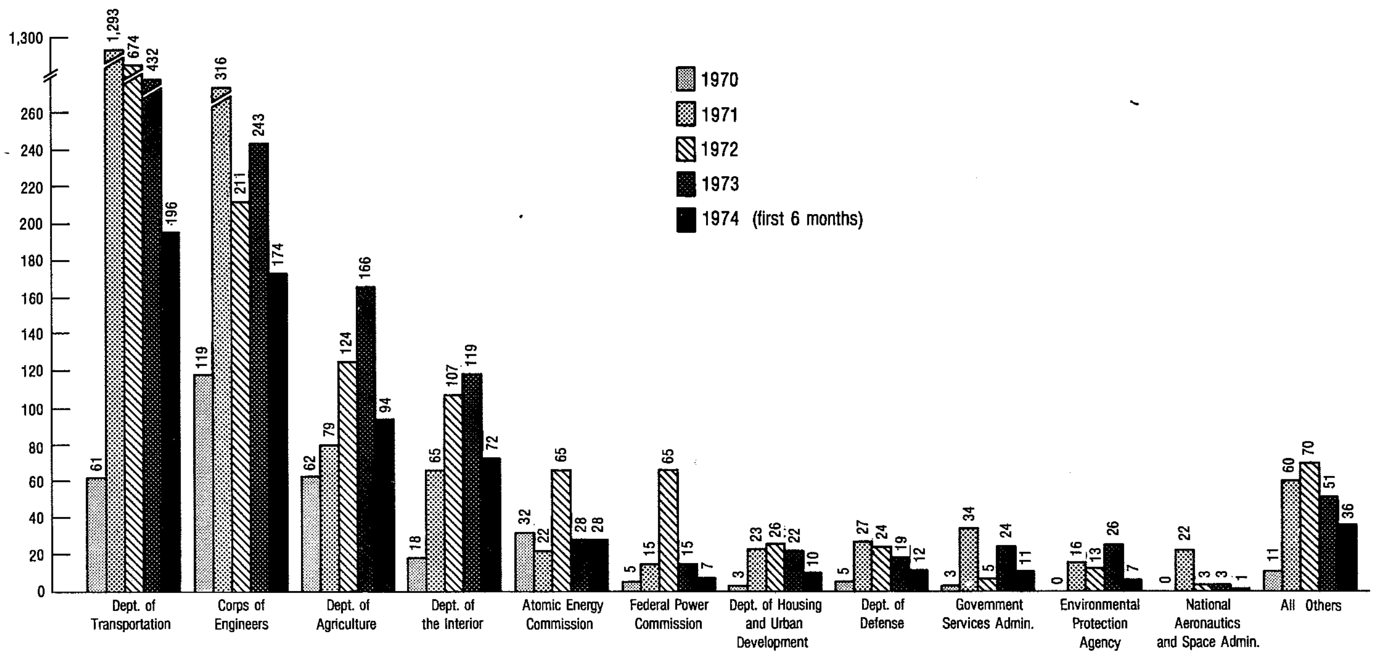
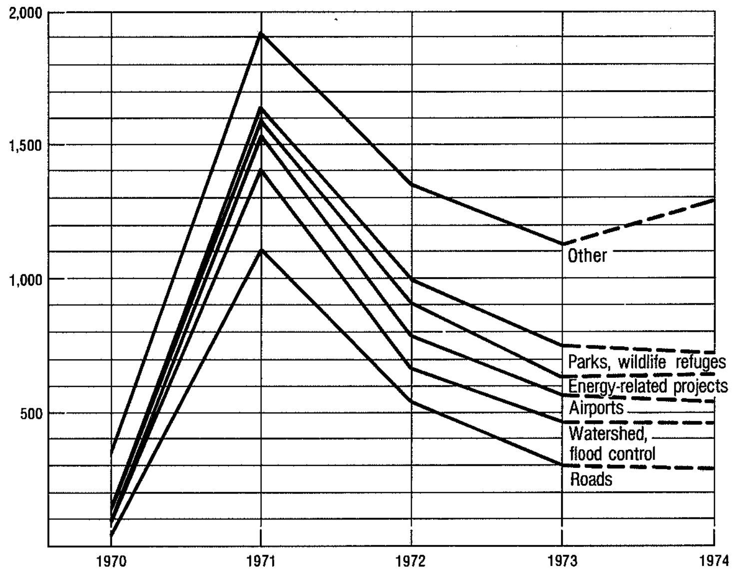


Figure 3

Environmental Impact Statements Filed Annually, by Project Type



statements annually prepared by a single agency. The Corps filed 243 statements in 1973, as compared with 211 in 1972, and is currently preparing statements at the rate of 396 per year. This increase appears to result primarily from the Corps' decisions to prepare analyses on a large number of projects initiated prior to the enactment of NEPA, and also on a larger proportion of its operation and maintenance activities. Corps of Engineers statements presently comprise 21 percent of all new statement filings.

During the last year, several agencies submitted impact statements for the first time. Among them were the Energy Policy Office (now the Federal Energy Administration),[36] the Architect of the Capitol,[37] and the Department of Labor.[38]

Diversity of Impact Statements

During 1973, impact statements were prepared for a broad range of actions, particularly in the energy field. The Energy Policy Office filed an impact statement on its priority system for the allocation of low-sulfur petroleum products.[39] The Department of the Interior filed impact statements on the sale of oil and gas leases on the outer continental shelf,[40] on the leasing of Federal lands for oil shale and

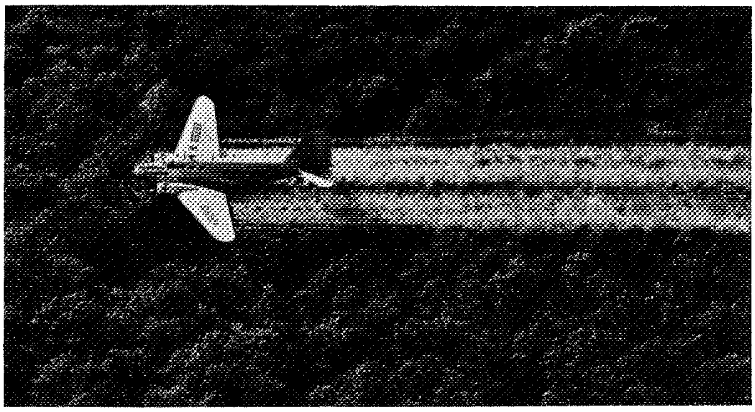
geothermal development,[41] and on its coal mining plans.[42] The statements on coal development are the first of a number to come. Each of them will be examining, for a different part of the country, the physical effects of proposed strip mining, the feasibility of reclamation, the competition between mining and existing uses of the land and water, and the comparative environmental costs of using coal as opposed to other energy sources.

During the last year, the Department of the Interior also prepared 28 environmental impact statements related to the Alaska Native Claims Settlement Act.[43] The statements analyze the consequences of the incorporation of about 80 million acres of Alaskan lands still within the unreserved public domain into the National Park, National Forest, National Wildlife Refuge, and National Wild and Scenic Rivers systems.

Several statements were prepared during the past year in the international area. One of the most important concerned the U.S. negotiating position at the United Nations Law of the Sea Conference which opened this summer in Caracas.[44] While the major thrust of the statement was on modes of developing hard mineral deposits in the deep seabed, the wide-ranging concerns of the Conference in such areas as territoriality, free navigation, and fishing rights were also covered. The State Department also prepared an impact statement on U.S. alternatives to improve the quality of Colorado River water that flows into Mexico.[45] Large U.S. diversions, combined with the high salinity of irrigation runoff, reduce the quality of the water that reaches Mexico to a level below that stipulated by mutual agreement between the two countries. The proposed desalinization plant is discussed in Chapter 5.

Impact statements covering state or local projects with major environmental implications also created intense interest this past year. For example, the Department of Transportation in 1973 issued a draft impact statement on the extension of interstate highway I–66 from suburban Virginia into Washington, D.C.[46] Of major concern here is the impact of the proposed highway on the metropolitan area. The impact statement analyzed whether mass transit or a highway/mass transit combination could better meet the metropolitan area's transportation needs.

The past year also saw a sharp increase in the number of "program statements," covering entire programs within an agency rather than a single action within the program, or the cumulative effects of a number of distinct but interrelated projects. For example, the Department of Agriculture analyzed its overall use of herbicides in various states and regions of the country through program statements;[47] the Department of Commerce prepared a program statement on its overall program for the construction of new tankers;[48] and the AEC filed a program statement on its development of the



Impact statements have been prepared by the Department of Agriculture on spraying of pesticides in National Forests.

liquid metal fast breeder reactor.[49] While program statements do not yet form a large proportion of the total number of statements, they offer an unprecedented opportunity to analyze major policy issues associated with the formulation of government programs. CEQ strongly encourages agencies to prepare such statements in the development of new programs and in the review or modification of programs already in operation.

Judicial Developments—1973–74

In a number of significant judicial developments during the past year, the courts elaborated on the rights of citizen groups to be compensated for their expenses in bringing a NEPA lawsuit, on the relationship between NEPA and land use planning, on the extent to which an agency can delegate the preparation of a statement, and on the standards to be applied in assessing the adequacy of an impact statement.

Legal Expenses of Citizen Groups in Bringing NEPA Lawsuits

American courts have traditionally barred recovery of legal expenses even by successful litigants. Only two narrow exceptions to this rule have generally been recognized. First, legal fees have been awarded in cases in which an opposing party has acted in bad faith, in order to punish the party's obdurate behavior.[50] The second exception covers cases in which a suit has conferred benefit on members of a clearly ascertainable class and an award of fees would serve to spread the costs of the litigation among these beneficiaries.[51]

Recently, a third exception to the general rule has emerged. Several courts concluded that the interests of justice require fee shifting where the plaintiff has acted as a "private attorney general" vindicating an important public interest.

In 1974, in *Wilderness Society* v. *Morton,*[52] the U.S. Court of Appeals for the District of Columbia ordered that the legal expenses of the Wilderness Society, the Environmental Defense Fund, and the Friends of the Earth be paid for their efforts as "private attorneys general" in the Trans-Alaska Pipeline case.[53] According to the court, not to award counsel fees in a case involving relatively little injury to single individuals but collectively great harm to important public interests could seriously frustrate the purposes of Congress.

> Where the law relies on private suits to effectuate Congressional policy in favor of broad public interests, attorney's fees are often necessary to ensure that private litigants will initiate such suits . . . Substantial benefits to the general public should not depend upon the financial status of the individual volunteering to serve as plaintiff or upon the charity of public minded lawyers.[54]

The court went on to say that:

> Our decision today may increase the willingness of skilled lawyers throughout the nation to undertake public interest litigation on behalf of unmonied clients with just, lawful, and important claims. This proposition we of course accept, and count it a happy result of our decision.[55]

The court observed that although the NEPA issue was resolved by Congress and not through litigation, the plaintiff's efforts in pursuing the issue deserved an award of attorney's fees. "Where litigation serves as a catalyst to effect change and thereby achieves a valuable public service, an award of fees may be appropriate even though the suit never proceeds to a successful conclusion on the merits." [56] The court pointed out that the public's interests had been substantially furthered as a result of the litigation. First, the permit conditions for the pipeline had been altered to provide for substantial additional protection of the environment. Second, under the new permit the government would receive fair market value for the use of its land rather than allowing the land to be used free, as had been the practice in the past. And third, the pipeline company would now be strictly liable for damages resulting from its use of the right-of-way. According to the court, the lawsuit had resulted in development of a substantially better project, and the plaintiffs were entitled to recover their expenses for having brought this about.

The court noted that, technically, only the Interior Department had violated the law. However, the court went on to point out that the Alyeska Pipeline Company had persuaded the government to grant the rights-of-way, had actively participated in the litigation, and "unquestionably was a major and real party at interest in this case." [57] Accordingly, the court determined that the government and Alyeska should each bear one-half of the citizen groups' expenses. However, since sovereign immunity bars imposition of

attorneys' fees against the United States (unless they are expressly provided for by an Act of Congress), only that portion to be borne by Alyeska could ultimately be assessed. Because of sovereign immunity, that part which would otherwise be borne by the government must be assumed by the citizen groups.

In dissenting to the court's opinion, several judges stated that in their view the citizen groups had not conferred any public benefit by their actions. The judges pointed out that the lower court had ruled against the plaintiffs on the issue of the adequacy of the final impact statement and implied that, at most, they should only be considered potentially eligible for reimbursement for work in connection with the Mineral Leasing Act issue, on which they ultimately prevailed.

Maryland–National Capital Park and Planning Commission v. Postal Service

This case [58] concerned the construction of a bulk mail facility for the U.S. Postal Service near Washington, D.C. The Maryland-National Capital Park and Planning Commission opposed construction of the facility and, in particular, urged that an environmental impact statement be prepared. The Corps of Engineers, as contractor for the U.S. Postal Service, prepared an environmental assessment and, on the basis of this assessment, concluded that no impact statement was required. All parties agreed that construction of the mail facility was a "major Federal action." Disagreement centered on whether the facility would "significantly" affect the environment. The U.S. District Court concluded that the Corps' determination that an impact statement was not required was not unreasonable,[59] and the plaintiffs appealed the decision to the U.S. Court of Appeals for the District of Columbia.

In rendering its decision, the Court of Appeals developed two major propositions. First, it pointed out that the proposed facility would be inconsistent with the local zoning for the facility site, and that this required an especially careful inquiry by the government into the potential significance of the project's environmental effects.

> The question of significance takes on a distinctive cast in the context of land-use planning. We think that much may turn on whether the Federal Government conforms to or deviates from local or regional regulations to land use. . . . When local zoning regulations and procedures are followed in site location decisions by the Federal Government, there is an assurance that such "environmental" effects as flow from the special uses of land—the safety of the structures, cohesiveness of neighborhoods, population density, crime control, and aesthetics—will be no greater than demanded by the residents acting through their elected representatives. There is room for contention, and there may even be a presumption, that such incremental impact on the environment as is attributable to the particular land use

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> proposed by the Federal agency is not "significant" . . . When, on the other hand, the Federal Government exercises its sovereignty so as to over-ride local zoning protections, NEPA requires more careful scrutiny.[60]

CEQ, in § 1500.8(a)(2) of its guidelines, has pointed out the need for agencies to carefully inquire into the relationship between their proposed project and land use plans for the affected area. This decision highlights the need to do so, not only in the writing of an impact statement but also in making the threshold decision of whether a project will significantly affect the quality of the environment.

The second major pronouncement by the Court of Appeals concerned the procedures to be followed in judicial review of an agency's "negative assessment." The court stated that, in general, three basic questions need to be addressed:

> First, did the agency take a "hard look" at the problem, as opposed to bald conclusions, unaided by preliminary investigation . . . Second, did the agency identify the relevant area of environmental concern . . . Third, as to problems studied and identified, does the agency make a convincing case that the impact is insignificant. . .[61]

The court in this instance was unable, on the basis of the information before it, to answer all the questions in favor of the government and thus remanded the case to the District Court for further investigation. The court's opinion makes it clear, however, that an agency must be able to demonstrate to a court, in any case of arguably significant environmental impact, that it has investigated the environmental effects of the proposed action. If an agency has decided not to prepare an impact statement, it must further be able to document, with analysis "as opposed to bald conclusions," that the effects of the proposed action will clearly not be significant.

Agency Delegation of the Preparation of the Impact Statement

During the last few years, legal challenges have been made to a number of impact statements because they were written by a private party or a state agency rather than the cognizant Federal agency. Plaintiffs have argued that NEPA requires a Federal agency to prepare its own impact statement and that this responsibility may not be delegated. According to plaintiffs, the delegation of the preparation of a statement to an interested outside party risks the production of a biased analysis rather than an objective independent study and thus contravenes the policies of NEPA. Courts have so far responded to these challenges with somewhat conflicting decisions.

In *Greene County Planning Board* v. *Federal Power Commission*,[62] the U.S. Court of Appeals for the Second Circuit held that the FPC's use, in connection with public hearings on an applicant's proposal, of the applicant's environmental analysis rather than an impact state-

ment independently prepared by its own staff, violated the policies of NEPA. According to the court,

The Federal Power Commission had abdicated a significant part of its responsibility by substituting the statement of [the applicant] for its own. The Commission appears to be content to collate the comments of other federal agencies, its own staff and the intervenors and once again to act as an umpire. The danger of this procedure, and one obvious shortcoming, is the potential, if not the likelihood, that the applicant's statement will be based upon self-serving assumptions.[63]

The court went on to point out that

intervenors generally have limited resources, both in terms of money and technical expertise, and thus may not be able to provide an effective analysis of environmental factors. It was in part for this reason that Congress has compelled agencies to seek the aid of all available expertise and formulate their *own* position early in the review process.[64] (emphasis added)

In *Conservation Society* v. *Secretary*,[65] the court reached a similar conclusion in holding that a highway impact statement prepared by a state highway agency and then reviewed by the Federal Highway Administration did not satisfy NEPA. According to the decision, NEPA requires that a statement be prepared by the responsible Federal agency, not the recipient of the proposed Federal aid.

Several other cases, however, have reached somewhat contrary conclusions. In *Life of the Land* v. *Brinegar*,[66] the U.S. Court of Appeals for the Ninth Circuit concluded that NEPA was satisfied by the Federal Aviation Administration's active participation in, and review of, an impact statement covering a proposed runway project, even though the statement was prepared by a private consulting firm which had a financial interest in the approval of the project. In *Citizens Environmental Council* v. *Volpe*,[67] the U.S. Court of Appeals for the Tenth Circuit held that the Department of Transportation's review and adoption of a highway impact statement that was prepared by the state highway agency was consistent with the goals of NEPA. Similar conclusions were reached in *Movement Against Destruction* v. *Volpe*,[68] *Citizens* v. *Brinegar*,[69] *Iowa Citizens for Environmental Quality* v. *Volpe*,[70] *National Forest Preservation Group* v. *Butz*,[71] and *Northside Tenants' Rights Coalition* v. *Volpe*.[72]

At the present time, then, there appears to be some disagreement within the judicial system on the extent to which the preparation of an impact statement may be delegated to an interested private party or state agency. No court has yet held that a Federal agency may fully delegate the preparation of a statement to such an outside group. At least some review of the statement by the Federal agency appears necessary, as does assumption of responsibility by the Federal agency for the adequacy of the environmental analysis contained in the statement. At the same time, the courts appear to differ on the extent to which a Federal agency must engage in an independent environmental analysis.

CEQ has traditionally not objected to delegation of the preparation of a statement in those instances where the Federal agency has main-

tained responsibility for the objectivity and adequacy of the statement.[73] Efficient use of resources suggests that the party closest to the development of a project should engage in at least its preliminary environmental analysis. Where this party is a state or local government, the responsibility of the Federal agency is to ensure that environmental considerations are meaningfully integrated into the project's design. This requires at least some review of the project and the impact statement by the agency. But it does not require an agency in every case to engage in an independent preparation of the impact statement.

At the present time (August 1974) Congress is considering delegation of the implementation of NEPA in connection with the Housing Act of 1974. This Act will provide for block grants to local units of government. In many cases, the local units of government will be able to use the grants without prior approval by the Department of Housing and Urban Development of the specific projects or programs to be financed. In such cases, the local unit of government will be required, under the Housing Act of 1974, to prepare an impact statement that would otherwise be required of HUD by NEPA. HUD will retain responsibility to assure that procedures providing for full review of environmental factors are faithfully followed. In general, HUD's involvement in the preparation of an impact statement under the Housing Act of 1974 will vary directly with the degree of its participation in the design or approval of the projects and programs which are funded.

Where the party closest to the project is a private applicant, somewhat greater involvement by the Federal agency is required. Private projects frequently do not reflect the public's concern for the preservation and enhancement of the environment to the same extent as do state and local government projects. CEQ has thus not supported the practice of allowing private applicants for Federal permits to prepare the entire impact statement, which is in turn circulated by the agency as its own.

Adequacy of an Impact Statement

In a major court decision, *National Helium* v. *Morton*,[74] the U.S. Court of Appeals for the Tenth Circuit ruled on the general test to be applied by a court in determining the adequacy of an agency's impact statement. The court pointed out that one must distinguish between judicial review of an agency's final decision for compliance with the Administrative Procedures Act [75] and judicial review of the agency's environmental impact statement for compliance with NEPA. In carrying out this latter inquiry, the court held that the "rule of reason" is the appropriate standard. According to the court,

> [O]ur view is that the review of the FES [final environmental impact statement] is limited to the following:

(1) Whether the FES discusses all of the five procedural requirements of NEPA.
(2) Whether the environmental impact statement constitutes an objective good faith compliance with the demands of NEPA.
(3) Whether the statement contains a reasonable discussion of the subject matter involved in the five required areas.[76]

After reviewing the impact statement prepared by the Department of the Interior, the court concluded that the statement was "fully acceptable." The court pointed out that NEPA

should not be viewed as necessitating that the completion of an impact statement be unreasonably or interminably delayed in order to include all potential comments or the results of works in progress which might shed some additional light on the subject of the impact statement. Such a result would inordinately delay or prevent any decision in environmental cases. The court should look for adequacy and completeness in an impact statement, not perfection.[77]

International Developments

NEPA has had unique and important effects on the international community. That this domestic law should have such an impact testifies to its particularly broad administrative scope and to its conceptual strength. U.S. agencies have directly contributed to the Act's international importance and influence through their own NEPA processes. At the same time a number of other countries have recognized that adoption of the impact statement mechanism can fill critical needs for forecasting environmental effects.

Use of NEPA in International Affairs

Impact statements of U.S. agencies can promote environmental quality in the international community in a variety of ways. First, because Section 102(2)(C) of NEPA applies to all U.S. agencies, several have prepared guidelines covering at least some of their activities abroad. This has been done by the State Department [78] and the National Science Foundation.[79]

A second use for U.S. impact statements involves their preparation in draft prior to the conclusion of international agreements affecting the human environment. Thus, impact statements have been prepared for the Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter,[80] the Convention on International Trade in Endangered Species of Wild Fauna and Flora,[81] the 1973 Convention on the Prevention of Pollution from Ships,[82] and for the draft agreement which may emerge from the Law of the Sea Conference. Such statements give environmental and other groups the opportunity to assess the effects of, and to comment on, proposed international agreements before they are actually ratified.

Finally, impact statements have international significance when they describe the international environmental effects of an action occurring within the United States. Impact statements have been filed for a number of internationally important activities, such as the Colorado River International Salinity Control Project, affecting Mexico, and the Bureau of Reclamation's Garrison Diversion project, in North Dakota, discussed in Chapter 5, which may cause water pollution problems in Canada. Such statements have been made available to other countries, as, for example, when the AEC's 1971 impact statement on the nuclear explosion in Amchitka, Alaska, was provided to the Japanese and Canadian governments. More formal procedures might be employed in the future whereby affected countries, especially neighboring nations, would be asked to submit comments that would be circulated and integrated into the NEPA process. Nongovernmental groups in other countries, with demonstrated interests, might also be asked to participate in the impact statement comment process.

In each of these ways, the impact statement mechanism permits and encourages U.S. agencies to take a long-range international view of the environmental effects of their proposed actions.

Influence of NEPA on Environmental Policies Abroad

More subtle but perhaps more profound international effects of NEPA are evident from the attention being given to impact statements by other countries. This interest is remarkable because NEPA was designed to correct deficiencies in unique U.S. administrative procedures. However, because the Act in fact responded to problems of gaps in environmental forecasting and of closed agency decisionmaking found in many countries, its mechanisms have become widely studied outside the United States.

Impact statements have been adopted or planned in Australia at both the state and the federal level. Experience there has focused on such states as Tasmania, where impact studies were required in 1973 and a public review process was established under the Director of Environmental Control.[83] Other Australian states have adopted similar procedures. The Australian Federal Government has established an interim policy on impact statements for Federal projects, pending the enactment of new legislation.

In Canada, federal environmental impact statement requirements were established by Environment Canada in April 1974.[84] Israel also recently required its Environmental Protection Service to establish an impact statement procedure.

In Europe no country has yet adopted the impact statement mechanism, although it has evoked considerable interest there. The West German Government, for example, has begun internal discussions on the ways in which impact statement processes might be

adapted to its particular institutional and legal system. Other countries and the Organization for Economic Cooperation and Development have revealed similar interests. Impact statements have been less attractive to many European countries whose existing land use licensing or permit systems already provide extensive control over environmental abuse.

Clearly the effect of the impact statement mechanism abroad will require careful consideration before it can complement the existing problems and procedures of other countries. Nevertheless, as a method for determining in advance the impacts of various alternative proposals and as a way in which to open the governmental decisionmaking process to new, outside scrutiny, it has already demonstrated its broad international appeal. Over the next several years there will be a great many opportunities within the international community to foster the increased understanding and usefulness of the impact statement process.

State Environmental Impact Statement Requirements

Since 1970, 21 states and the Commonwealth of Puerto Rico have adopted environmental impact statement requirements similar to those set forth in NEPA.[85] Thirteen of the 21 states and the Commonwealth of Puerto Rico have legislatively adopted a comprehensive EIS requirement: California, Connecticut, Hawaii, Indiana, Maryland, Massachusetts, Minnesota, Montana, North Carolina, South Dakota, Virginia, Washington, and Wisconsin.[86] Three states—Michigan, New Jersey, and Texas—have administratively promulgated a comprehensive EIS requirement.[87] In addition, five states require preparation of impact statements on specific classes of projects.[88] Arizona requires that impact statements be prepared for proposed water-oriented projects.[89] Georgia requires an environmental analysis for certain toll road projects.[90] In Nevada, there is a special provision relating to utility power plant siting.[91] Nebraska's Department of Roads prepares impact statements on State-funded highway projects.[92] Delaware requires the preparation of statements in connection with the issuance of permits under its Coastal Zone Act and its Wetlands Law.[93]

A number of American cities have also initiated environmental impact statement programs. New York City's Environmental Protection Administration, operating under an executive order,[94] may require impact statements on designated city activities. In Bowie, Maryland, a city ordinance [95] highlights the utility of environmental impact statements in local government decisionmaking.

The Appendix to this chapter lists the states and local governments which, as of August 1, 1974, have adopted an impact statement process. For each state or local government, the Appendix contains citations to the legal authority for the process; any guidelines which

have been issued as of August 1; and the name, address, and phone number of individuals who may be contacted for further information.

At least 15 other states are now considering the establishment of impact statement requirements. To aid states in developing such legislation, the Council of State Governments approved a suggested State Environmental Policy Act.[96] One state, New Mexico, recently repealed its environmental impact statement process, as discussed below.

Although the various state programs differ from NEPA in several respects, most have used the Federal law as their model. To date, implementation of the state programs has moved slowly, and the visible benefits are still limited. Considering the very limited funds and staff allocated to implement the requirements, most state agencies seem to be putting forth a good effort.

In the Council's view the state impact statement process has great potential. Statements prepared by state agencies and local governments usually cover projects that are not within the reach of the Federal impact statement process. In addition, statements prepared by state agencies and local governments may prove to be more responsive to local needs than the Federal statements have been.

Integration of a state EIS process into a state's decisionmaking will take some time. Apart from the problem of resource constraints, many states have no tradition of providing detailed documentation and analysis to assist decisionmaking. Hence, the impact statement process has created uncertainties on the state level which do not exist at the Federal level. One major question with which states have been grappling is how the EIS should be used: Is it to be a policy tool or solely a means to document the impact of an individual project? This issue can be resolved, but where it remains unsolved, the integration of the EIS process into many state programs has been delayed.

Contents of a Statement

Most of the state acts and executive orders closely follow NEPA with respect to the required items to be discussed in the impact statement. Indeed, Puerto Rico, Indiana, and Washington follow exactly NEPA's list of items to be included in the EIS. Some states have added new elements which are likely to increase the utility of the document; the most significant of these are mitigation measures, growth-inducing impacts, and economic impacts.

Massachusetts chose to narrow the scope of the impacts to be analyzed to those relating to natural environmental resources.[97] Michigan, on the other hand, refers specifically to effects on "human life." [98] Texas and Wisconsin explicitly require that the "beneficial" aspects of a proposal be discussed as well as the adverse impacts.[99]

The Minnesota law contains two innovative departures from the Federal model. The EIS must include an assessment of the "impact

on state government of any Federal controls associated with the proposed actions" and a discussion of the "multistate responsibilities associated with the proposed actions." [100]

California's act was the first to require that the EIS include a discussion of the mitigation measures proposed to minimize the impact of a project.[101] Similar clauses are included in the Maryland, Massachusetts, North Carolina, and Virginia acts and in the suggested State Environmental Policy Act approved by the Council of State Governments.[102] NEPA itself does not specifically require this, but the NEPA Guidelines do discuss mitigation under the category of alternatives to the proposed action.[103]

The California law and the model act require an analysis of the "growth-inducing impact of the proposed action." [104] Montana recently revised its guidelines to require consideration of growth-inducing impacts and the use of energy.[105]

A major addition to the Federal model is the inclusion of the economic impact of proposed actions. Connecticut, Michigan, Minnesota, Montana, and Wisconsin have adopted this requirement.[106] Some local jurisdictions in California require an economic analysis in their impact statements. The Michigan order calls for, "[w]here appropriate, a discussion of the economic gains and losses including the effect on employment, income levels, property taxes, and the cost of alternatives to the proposed action." [107] The Federal guidelines require only that an impact statement deal with "changed patterns of social and economic activities" in a discussion of the secondary consequences of a proposal.[108]

Applicability to State, Local, and Private Projects

All of the state laws require impact statements for major actions or projects undertaken directly by state agencies. The states differ greatly, however, in their application of the impact statement process to local government actions and to private activities which require a governmental permit. Because some of the most significant controls over private actions, particularly those relating to the use of land, are administered by counties, cities, towns, and special purpose units of local government, the effectiveness of a state's impact statement is greatly dependent on whether it applies to local governments and to private activities.

NEPA provides for impact statements to be prepared on actions "involving a Federal lease, permit, license certificate or other entitlements." [109] This provision has been interpreted to mean that an impact statement may be needed for what is basically a private action, if a Federal permit is required, as in the Trans-Alaska Pipeline case. Most states utilize similar wording in corresponding portions of their laws, but the interpretations have not always been the same.

Governor for action on a project.[129] In Virginia, the State Comptroller is directed not to release funds for a project if it does not meet environmental approval.[130]

The Minnesota Environmental Quality Council (EQC) has the authority to require that a statement be prepared if it receives a petition with 500 or more signatures and material evidence of the need for an environmental review.[131] The EQC can also require revisions of inadequate impact statements and delay implementation of an action. It can "reverse or modify the decisions or proposals where it finds, upon notice and hearing that the action or project is inconsistent" with the broad statement of environmental policies and standards set forth in the law.[132] Minnesota is the only state with such explicit powers to affect the disposition of projects. Its law is now being implemented, and the extent to which the EQC will exercise this power remains to be seen.

Most states do not have accurate statistics on the extent to which the process is operating. Except for California and Washington, it appears that relatively few impact statements are being prepared. California estimates that 6,000 statements per year are being issued, and Washington estimates 200 statements per year. In the other states, the range is between 10 and 50 statements a year, in part because few statements are being required for private actions. In some states, no impact statements have been prepared because their laws have not yet been implemented.

Public Participation

The burden of enforcing EIS requirements often falls on citizen groups. Like NEPA, most state laws and executive orders require that copies of impact statements be made available to the public. Several state laws do not make reference to the public at all. How citizens are in practice to be included in the EIS process is left to the state guidelines, which are often not specific.

California's guidelines provide that agencies should make provisions in their procedures for wide public involvement.[133] Michigan's regulations call for "maximum use of public involvement procedures and public hearings." [134] North Carolina specifies that agencies should consult with the public "if deemed appropriate." [135] Puerto Rico's guidelines state that an issuing agency may proceed with its action only after time has been allowed for public response to the final EIS.

California, North Carolina, and Virginia periodically issue lists of impact statements that have been prepared during the preceding month. Wisconsin's law calls for notice of a hearing on a statement to be published in a newspaper in the affected area, and hearings are held on all impact statements.[136] An attempt is made to involve the public early in the process by having environmental groups assist in preparing the environmental assessments. The Massachusetts

guidelines direct agencies to give notice of a draft statement in a newspaper in the affected area and in a statewide paper.[137] Massachusetts also uses the University of Massachusetts and the Institute for Man and His Environment to assist the State in the review of impact statements. Minnesota requires in its regulations that public hearings be held on all draft impact statements. The State also has an early notice system to notify the public of pending State actions.[138]

In general, enforcement of the state impact statement process and involvement of the public has so far been spotty. Until the process is applied to a broad range of activities, and a number of statements are prepared and circulated to the public, experience at the Federal level indicates that the process is unlikely to have a substantial effect on individual projects or agency decisionmaking.

California Law

Because California's Environmental Quality Act (CEQA) has had the broadest effect of any of the state "little NEPA's," it is useful to look at its implementation more closely. It has become one of the most important tools for land use control in California, mainly because of the court ruling that the law applies to private as well as public projects. Although the Act defines the environmental impact report (EIR) as an "informational document," CEQA has in actuality been a flexible device. Some California counties have used it as a regulatory measure, to test submitted plans after the fact. In other counties it has been used as a planning tool.

Various alternative management approaches have been taken by the counties and the state agencies. On the state level, most draft EIR's are prepared by the individual agencies. On the local level, draft EIR's have been prepared either by the municipality or a consultant hired by it. The amendments in 1972 ended the practice whereby statements had been prepared by consultants hired by the developer. The draft EIR which is sent out for public review "must reflect the judgment of the lead agency." [139] The impact report requirement seems to have been so widely applied to private activities that financial institutions in some counties have been requiring an environmental analysis as part of the preliminary feasibility appraisal of development projects proposed for financing.

The very presence of the impact report process has had an effect on the mode of developer operation. For example, the Irvine Company, owners of the giant Irvine Ranch in Orange County, prepared an EIR on a completed grading project immediately after the *Friends of Mammoth* decision was handed down. The EIR showed that substantial adverse impacts had resulted that could have been mitigated or avoided. At the same time, the Irvine Company prepared an EIR on a community plan in another part of the ranch, but this one was prepared in conjunction with the planning of the project. A number

This situation is rapidly changing. Substantial effort has recently been channeled into developing an understanding of how to forecast the major environmental effects of government activities. Federal agencies, universities, industry, consulting firms, environmental groups, and others are working out methodologies for carrying out environmental analysis. For example, EPA and the Institute of Ecology are developing substantive frameworks for the environmental analysis of certain types of governmental projects, such as highways and sewage treatment plants. The U.S. Geological Survey is studying the interrelationships between generic types of activities (such as construction) and their environmental effects. The Environmental Law Institute and the International Biological Program of the National Science Foundation are focusing on types of ecological systems, such as floodplains and coastal zones, in an attempt to find methodologies for forecasting the impact of man's activities on these environments.

In addition to these long-term investigations into improving the quality of environmental analysis, a number of groups are working on methodologies and techniques for improving the quality of analysis in the short term. For example, CEQ, in cooperation with EPA, NSF, and the AEC, this year developed the MERES model, a tool for projecting the nature and quantity of air pollutants, water pollutants, solid waste, and land disruption associated with different forms of energy production. This model (which is discussed in more detail in Chapters 3 and 6) should help substantially in the quantification of the environmental effects of energy projects. Also this year, virtually all Federal agencies substantially involved in the field of energy—FEA, AEC, FPC, Interior, EPA, and CEQ—are jointly sponsoring a contract to develop a reference document containing the latest information on the environmental effects of every type of energy system. This document will be used in the development of impact statements for comparing a proposed action with the alternatives available.

These efforts and others like them will result in increased ability to prepare useful and accurate environmental forecasts. While the pace at which these new tools will be adopted is unclear, the amount of resources annually expended in writing impact statements and the large increase in their usefulness that can be realized by developing substantive techniques and basic data required for their preparation, seems to assure further progress in improving the quality of impact statements.

Scope of Environmental Analysis

Impact statements usually analyze the initial or primary effects of a project, but they very often ignore the secondary or induced effects. A new highway located in a rural area may directly cause

increased air pollution as a primary effect. But the highway may also induce residential and industrial growth, which may in turn create substantial pressures on available water supplies, sewage treatment facilities, and so forth. For many projects, these secondary or induced effects may be more significant than the project's primary effects.

It has taken several years to recognize this shortcoming in the analysis contained in many impact statements. The problem now is to develop better methodologies for predicting secondary impacts. During this past year CEQ sponsored studies which investigated the secondary environmental effects likely to result from the establishment of deepwater ports and from the drilling for oil and gas on the outer continental shelf. These studies looked at the onshore development, such as the construction of oil refineries and petrochemical complexes, which were likely to result from offshore activities and sketched out the environmental effects of the onshore development.

CEQ is also sponsoring, in cooperation with EPA and HUD, an analysis of the secondary effects of public infrastructure projects, such as highways and sewage treatment plants. The purpose of this study is to help develop a framework for predicting what patterns of land development may result from such infrastructure projects and what the environmental effects of the different land development patterns may be.

While the analysis of secondary effects is often more difficult than defining the first-order physical effects, it is also indispensable. If impact statements are to be useful, they must address the major environmental problems likely to be created by a project. Statements that do not address themselves to these major problems are increasingly likely to be viewed as inadequate. As experience is gained in defining and understanding these secondary effects, new methodologies are likely to develop for forecasting them, and the usefulness of impact statements will increase.

Timing of the Preparation of Impact Statements

Compliance with the letter of NEPA (rather than its spirit) requires an agency, at a single point in the development of a project, to prepare an environmental analysis. But having the analysis available at a late date is not very helpful to the planning of a project. Rather, an environmental analysis needs to be prepared as a rough approximation during the initial planning of a project and then gradually refined as the planning of the project proceeds and as alternatives are identified, analyzed, and perhaps discarded. In this way, the environmental analysis at each stage in the planning process is appropriate to the decisions to be made at that stage. The project can be scrapped if its environmental costs appear to be too great, without wasting significant resources. Alternatively, the project can be modi-

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fied in ways which achieve the objective without entailing unacceptable and/or avoidable environmental costs.

This procedure is analagous to the way in which the economic analysis of a project is currently made. Planning begins with a rough estimate of the economic costs and benefits. This is gradually refined as the detailed planning of the project progresses. If the economics of the project appear at any point to be highly unfavorable, the project is generally modified or abandoned, and there is no waste of substantial amounts of money or time because sponsors were unaware of fundamental difficulties with the project.

Consideration of environmental factors needs to proceed in much the same way as consideration of economic factors. If environmental analysis is approached in this way, the NEPA-required impact statement emerges in the normal course of events. No formal decision on whether to prepare an impact statement is then required, and the requirement for the statement does not bring about a jolt in an agency's operations. And the crucial goal of NEPA—consideration of the environment in the planning of a project—is accomplished.

As experience demonstrates the benefits which environmental analysis can bring to the design of a project, the Council expects this alternative approach will increasingly replace the current one-shot impact statement method.

Size of Impact Statements

In the future, it seems quite possible that the size of impact statements will eventually decrease. As the relevance of different types of information becomes apparent, the current approach of some agencies simply to catalog an enormous variety of facts should slowly begin to change. Many impact statements now resemble encyclopedias. They discuss the project's setting in overly elaborate detail and contain lengthy descriptions of all species of plant and animal life in the affected area. Frequently, this reflects a lack of understanding of what is important and what is not. As the crucial environmental questions start to come into focus, it should become increasingly clear that much of this verbiage can be dispensed with, thus helping to reduce the size of many of the statements.

CEQ has encouraged agencies to streamline their impact statements by focusing most of their efforts on a discussion of the environmental effects of the proposal and its alternatives. Within this area of focus, agencies should further concentrate on the most important findings or conclusions in their analysis. The purpose of the impact statement process is to help develop an environmentally sound project; it is not to develop a lengthy document which may obscure the major issues. Courts appear to be increasingly engaging in careful reviews of the legal adequacy of a statement and may

be expected to reject statements which miss raising, and attempting to resolve, these major issues.

Over the long term, as the level of knowledge of how to do impact statements increases, the cost of preparing them should begin to decrease. It may take several years for environmental analysis to be reduced to a routine type of inquiry; some may argue that it could take a decade or two. But the efforts to improve the impact statement process point in this direction, and it seems likely that over the long term there will be a decrease in the cost of preparing statements.

The Council has strongly encouraged agencies to prepare program statements. Frequently, basic policy issues in the operation of a program can be addressed only in an analysis which covers the whole program; at the project level, it is often not feasible to review these basic questions. In addition, preparation of a program statement may allow an agency to dispense with the preparation of impact statements on individual projects, provided that impacts at the site are not substantial. Even if such impact statements cannot be dispensed with, however, they can often be reduced in size if the program statement already covers many of the impacts. Thus, preparing program statements may help to increase the efficiency of the NEPA process. As the transition to program statements advances, the Council anticipates that the size and cost—and possibly even the number—of impact statements will eventually be reduced.

Conclusion

NEPA is alive and well. It has passed through a transition period, during which agencies have become aware of the Act's widespread requirements, and the basic structure of the environmental impact statement process has been firmly established. NEPA has emerged as an integral and essential part of all Federal agencies' activities.

The foresight of Congress in passing NEPA has been widely recognized by state and local governments and foreign countries. Twenty-one states and the Commonwealth of Puerto Rico have so far adopted an impact statement process patterned after NEPA, as have a number of local governments and foreign countries. The benefit of such a process is now well proven.

The basic challenge over the next few years is to improve the quality of environmental analysis. While the statements written today are generally much more comprehensive and detailed than those written a few years ago, there is still room for improvement. CEQ and others are devoting a major part of their resources to this endeavor, and encouraging signs already exist. Overall, NEPA promises to become a major landmark in the development and administration of Federal Government programs.

Footnotes

1. National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. §§ 4321–4347 (Jan. 1, 1970). The full text of NEPA appears in Appendix B.
2. CEQ, *Third Annual Report* (1972), pp. 1–59.
3. Lynton K. Caldwell, testimony in *Hearings on S. 1075, S. 237 and S. 1752 before the Committee on Interior and Insular Affairs, U.S. Senate* (April 16, 1969), pp. 112–35.
4. *Wilderness Society* v. *Hickel,* 325 F. Supp. 422, 1 ERC 1335, 1 ELR 20042 (D. D.C. 1970), *rev'g denial of application for intervention, sub nom. Wilderness Society* v. *Morton,* 463 F.2d 1261, 4 ERC 1101, 2 ELR 20250 (D.C. Cir. 1972), *further injunction denied,* 4 ERC 1467, 2 ELR 20583 (D. D.C. 1972), *rev'd* 479 F.2d 842, 4 ERC 1977, 3 ELR 20085 (D.C. Cir. 1973).
5. CEQ, *Guidelines for Statements on Proposed Actions Affecting the Environment,* 36 Fed. Reg. 7724 (1971).
6. Bureau of National Affairs, *Environment Reporter,* 3:82–87 (May 19, 1972).
7. Council on Environmental Quality, *Guidelines for Statements on Proposed Actions Affecting the Environment,* 36 *Fed. Reg.* 20550 (August 1, 1973). (Hereafter cited as *CEQ Guidelines*). The full text of the *Guidelines* is reproduced as Appendix D of this report.
8. Atomic Energy Act of 1954, Ch. 1073, 68 Stat. 921 (1954), *as amended* 42 U.S.C. § 2011 *et seq.* (1964), *as last amended* P.L. 92–314, 86 Stat. 227, 42 U.S.C. § 2201 (1972).
9. P.L. 91–560, 84 Stat. 1472, 42 U.S.C. §§ 2131–2140 (1970).
10. Atomic Energy Commission, *Report on AEC Implementation of the National Environmental Policy Act in Its Licensing and Regulation of Nuclear Facilities (Nuclear Understanding and Public Acceptance),* (1972), pp. 3–5, presented by Lester Rogers, Director, Division of Radiological and Environmental Protection, Atomic Energy Commission, Anaheim, California (March 13–16, 1972).
11. See 10 C.F. R. Part 50, Appendix D (December 4, 1970).
12. *Calvert Cliffs' Coordinating Committee* v. *AEC,* 449 F.2d 1109, 2 ERC 1779, 1 ELR 20346 (D.C. Cir. 1971).
13. Statement by AEC Chairman James Schlesinger, issued August 27, 1971.
14. For discussion of AEC adjustment to the *Calvert Cliffs'* decision, see Atomic Energy Commission document, *Statement by L. Manning Muntzing, Director of Regulation, AEC, FY 1973 Authorization Hearings Before the Joint Committee on Atomic Energy* (March 9, 1972).
15. Atomic Energy Commission, *Preparation of Environmental Reports for Nuclear Power Plants,* issued March 1973.
16. Atomic Energy Commission, presentation to the Council on Environmental Quality, *AEC Regulatory Implementation of NEPA* (from the expanded outline), by A. Giambusso, AEC Deputy Director for Reactor Projects, at 10 (March 6, 1973).
17. Organic Administration Act of 1897, Act of June 4, 1897, 30 Stat. 34, *as amended,* 16 U.S.C. §§ 473–478, 479–482, 551 (1897); Multiple Use-Sustained Yield Act, P.L. 86–517, 74 Stat. 215, 16 U.S.C. §§ 528–531 (1960).
18. Address by Chief Forester Edward P. Cliff, Washington, D.C., January 1971.
19. Forest Service, *Framework for the Future* (Feb. 1970).
20. Forest Service, *Emergency Directive 1,* Forest Service Manual (1940) (July 13, 1971).
21. Forest Service, *Emergency Directive 1,* Forest Service Manual (1940) (November 9, 1971).

22. D. Ross Carder and Clarkson H. Oglesby, *Unified Planning and Decision Making: A Conceptual Framework for Forest Service Management,* prepared for incorporation into doctoral dissertation, Stanford University (October 1973).
23. *E.g.,* Forest Service, Federal Resource Report No. 20, *The Outlook for Timber in the United States* (October 1973); Forest Service, *National Forest Management in a Quality Environment—Timber Productivity* (1971).
24. See Forest Service, *National Forest Management in a Quality Environment—Timber Productivity,* at i–ii (March 1971).
25. *CEQ Guidelines,* 38 *Fed. Reg.* 20550 (August 1, 1973).
26. CEQ, *An Evaluation of Implementation and Administration of NEPA by the Forest Service and the Bureau of Land Management* (Preliminary Report, Feb. 1974); CEQ, *A Study of the Implementation of NEPA by the United States Navy* (March 1974).
27. Roger W. Findley, "The Planning of a Corps of Engineers Reservoir Project: Law, Economics and Politics," 3 *Ecology Law Quarterly* 1 (1973).
28. John Randolph, *New Melones, NEPA and the Political Process: The Effect of the National Environmental Policy Act on the Planning of New Melones Lake,* prepared for incorporation into doctoral dissertation, Stanford University (1974).
29. Environmental Protection Agency, Office of Federal Activities, *Guidelines for Review of Environmental Impact Statements—Vol. 1: Highway Projects* (September 1973); *Manual for Preparation of Environmental Impact Statements for Waste Water Treatment Works, Facilities, Plans and 208-Area-Wide Waste Treatment Management Plans* (July 1974).
30. Federal Water Pollution Control Act Amendments of 1972, P.L. 92–500, 86 Stat. 816, 33 U.S.C. 1151 *et seq.,* § 511(c)(1) (1972).
31. Clean Air Amendments of 1970, P.L. 91–604, 84 Stat. 1676, 42 U.S.C. § 1857 *et seq.,* (1970).
32. The Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S.C. §§ 135–135K (1970).
33. *Portland Cement Association* v. *Ruckelshaus,* 486 F. 2d 375, 5 ERC 1593, 3ELR 20642 (D.C. Cir. 1973); *EDF* v. *EPA,* 489 F.2d 1247, 6 ERC 1112, 4 ELR 20031 (D.C. Cir. 1973).
34. The Energy Supply and Environmental Coordination Act of 1974, P.L. 93–319, § 7(c)(1) (June 22, 1974).
35. *39 Fed. Reg.* 16186 (May 7, 1974) (effective October 15, 1974).
36. Energy Policy Office (now Federal Energy Administration), Environmental Impact Statement, *Proposed Establishment of Priorities of Use and Allocation of Supply for Certain Low Sulfur Petroleum Products* (Final, November 8, 1973).
37. Architect of the Capitol, Environmental Impact Statement, *Modifications to and Enlargement of the Capitol Power Plant, Washington, D.C.* (Draft, February 13, 1973).
38. Department of Labor, Environmental Impact Statement, *Proposed Regulation: Handling of Certain Carcinogens* (Final, October 2, 1973); Supplement—*Emergency Standards—Carcinogens* (December 3, 1973).
39. Energy Policy Office (now Federal Energy Administration), *supra* note 36.
40. *E.g.,* Department of the Interior, Environmental Impact Statement, *Proposed 1974 Outer Continental Shelf Oil and Gas General Lease Sale, Offshore Louisiana* (Final, January 23, 1974).

41. Department of the Interior, Environmental Impact Statements, *Final Environmental Impact Statement for the Geothermal Leasing Program* (Final, October 24, 1973), and *Final Impact Statement for the Prototype Oil Shale Leasing Program* (Final, August 29, 1973).
42. Department of the Interior, Environmental Impact Statement, *Crow Ceded Area Coal Lease Westmoreland Resources Mining Proposal* (Final, January 29, 1974).
43. Alaska Native Claims Settlement Act, Pub. L. 92–203, 85 Stat. 688, 43 U.S.C. §§ 1601–1624 (1971).
44. Department of State, Environmental Impact Statement, *Third U.N. Law of the Sea Conference* (Draft, May 29, 1974).
45. Department of State, Environmental Impact Statement, *Colorado River International Salinity Control Project,* (Draft, April 1, 1974).
46. Department of Transportation, Environmental Impact Statement, *I–66 Corridor Transportation Alternatives Study* (Draft, November 16, 1973).
47. Department of Agriculture, Environmental Impact Statements, *Vegetation Management with Herbicides: Deschutes, Winema, Ochoco and Fremont National Forests (Oregon)* (Final, July 25, 1973) and *The Use of Herbicides in Land Management: Washington, Idaho, Montana, North and South Dakota* (Final, November 14, 1973).
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49. Atomic Energy Commission, Environmental Impact Statement, *Liquid Metal Fast Breeder Reactor Draft Environmental Impact Statement* (Draft, March 8, 1974).
50. *Hall* v. *Cole,* 412 U.S. 1 (1973).
51. *Mills* v. *Electric Auto-Lite Co.,* 396 U.S. 375 (1970).
52. *Wilderness Society* v. *Morton,* 495 F.2d 1026, 6 ERC 1427, 4 ELR 20279 (D.C. Cir. 1974). An intention to appeal this decision has been indicated by Alyeska.
53. *Wilderness Soviety* v. *Hickel,* 325 F. Supp. 422, 1 ERC 1335, 1 ELR 20042 (D. D.C. 1970), *rev'g denial of application for intervention, sub nom. Wilderness Society* v. *Morton,* 463 F.2d 1261, 4 ERC 1101, 2 ELR 20250 (D.C. Cir. 1972), *further injunction denied,* 4 ERC 1467, 2 ELR 20583 (D.D.C. 1972), *rev'd* 479 F.2d 842, 4 ERC 1977, 3 ELR 20085 (D.C. Cir. 1973).
54. *Wilderness Society* v. *Morton,* 495 F.2d 1026, 1030, 6 ERC 1427, 1429, 4 ELR 20279, 20280 (D.C. Cir. 1974).
55. *Id.* at 1038, 6 ERC at 1434, 4 ELR at 20285.
56. *Id.* at 1034, 6 ERC at 1431, 4 ELR at 20282.
57. *Id.* at 1036, 6 ERC at 1433, 4 ELR at 20283.
58. *Maryland National Capital Park and Planning Commission* v. *Postal Service,* 349 F. Supp. 1212, 4 ERC 1655, 2 ELR 20656 (D. D.C. 1972), *remanded* 487 F.2d 1029, 5 ERC 1719, 3 ELR 20702 (D.C. Cir. 1973).
59. *Id.* at 349 F. Supp. 1212, 1214, 4 ERC 1655, 1656, 2 ELR 20656, 20657 (D.D.C. 1972).
60. *Id.* at 487 F.2d 1029, 1036, 5 ERC 1719, 1723, 3 ELR 20702, 20704 (D.C. Cir. 1973).
61. *Id.* at 1040, 5 ERC at 1725–26, 3 ELR at 20706.
62. *Greene County Planning Board* v. *Federal Power Commission,* 455 F.2d 412, 3 ERC 1595, 2 ELR 20017 (2d Cir. 1972), *cert den.* 409 U.S. 849 (1973).
63. *Id.* at 420, 3 ERC at 1599–1600, 2 ELR at 20020.
64. *Id.* at 420, 3 ERC at 1600, 2 ELR at 20020.
65. *Conservation Society of Southern Vermont* v. *Secretary of Transportation,* 362 F. Supp. 627, 5 ERC 1683, 3 ELR 20709 (D.C. Vt. 1973).

66. *Life of the Land* v. *Volpe,* 363 F. Supp. 1171, 5 ERC 1413, 3 ELR 20180 (D.C. Hawaii 1972), *aff'd sub nom. Life of the Land* v. *Brinegar,* 485 F.2d 460, 5 ERC 1780, 3 ELR 20811 (9th Cir. 1973), *motions granted to vacate stay and injunction* —— U.S. ——, 94 S. Ct. 558, 6 ERC 1047 (1973), *cert. den.* 6 ERC 1512 (1974).
67. *Citizens Environmental Council* v. *Volpe,* 364 F. Supp. 286, 4 ERC 1970, 3 ELR 20077 (D.C. Kan. 1973), *aff'd.* 484 F.2d 870, 5 ERC 1989, 4 ELR 20009 (10th Cir. 1973), *cert. den.* 6 ERC 1440 (1974).
68. *Movement Against Destruction* v. *Volpe,* 361 F. Supp. 1360, 5 ERC 1625, 3 ELR 20667 (D.C. Md. 1973), *aff'd.* 4 ELR 20278 (4th Cir. 1974).
69. *Citizens for Mass Transit Against Freeways* v. *Brinegar,* 357 F. Supp. 1269, 5 ERC 1231, 3 ELR 20746 (D.C. Ariz. 1973).
70. *Iowa Citizens for Environmental Quality* v. *Volpe,* 4 ERC 1755, 3 ELR 20013 (S.D. Iowa 1972), *aff'd.* 487 F.2d 849, 6 ERC 1088, 4 ELR 20056 (8th Cir. 1973).
71. *National Forest Preservation Group* v. *Butz,* 343 F. Supp. 696, 4 ERC 1535, 2 ELR 20571 (D.C. Mont. 1972), *rev'd* 485 F.2d 408, 5 ERC 1863, 3 ELR 20783 (9th Cir. 1973).
72. *Northside Tenants' Rights Coalition* v. *Volpe,* 346 F. Supp. 244, 4 ERC 1376, 2 ELR 20553 (E.D. Wisc. 1972).
73. See, *e.g., CEQ Guidelines,* § 1500.7(c), 38 *Fed. Reg.* 20550, 20553 (August 1, 1973).
74. *National Helium Corp.* v. *Morton,* 361 F. Supp. 78, 5 ERC 1545 (D.C. Kan. 1973), *rev'd* 486 F.2d 995, 6 ERC 1001, 4 ELR 20041 (10th Cir. 1973).
75. The Fourth, Fifth, Eighth, and District of Columbia Circuits have concluded that NEPA establishes standards against which a court can, under the Administrative Procedures Act, review the substance of an agency decision. The standard to be applied in carrying out this review is the "arbitrary, capricious, or abuse of discretion" standard. The Ninth and Tenth Circuits have concluded that NEPA creates only procedural requirements. In these circuits, no review of the substance of an agency decision, for compliance with the policies of NEPA, has yet been recognized.
76. *National Helium Corp.* v. *Morton, supra,* 486 F.2d at 1002–1003, 6 ERC at 1005, 4 ELR at 20044.
77. *Id.* at 1004, 6 ERC at 1007, 4 ELR at 20045.
78. Department of State, *Environmental Impact Statement: Issuance of Final Department Procedures for Compliance with Federal Environmental Statutes,* 37 *Fed. Reg.* 19167–19169 (September 19, 1972).
79. National Science Foundation, Circular No. 99, Rev. No. 2, § 6(b)(3) (February 28, 1974).
80. Department of State, Environmental Impact Statement, *Proposed Dumping Convention* (Final, December 2, 1973).
81. Department of the Interior, Environmental Impact Statement, *Endangered Species Convention* (Final, August 9, 1973).
82. Department of State, Environmental Impact Statement, *International Convention on Oil Pollution* (Final, December 19, 1972).
83. Staff Interview, Malcolm Baldwin, CEQ, with D. Pottinger, Director of Environmental Control, State of Tasmania, Australia, in Washington, D.C., July 11, 1974.
84. Environment Canada, News Release Communiqué, *Federal Government Developments to be Screened for Environmental Effects,* March 14, 1974.
85. See generally, Nicholas C. Yost, Esq., *NEPA's Progeny: State Environmental Policy Acts,* 3 ELR 50090 (1973); Thaddeus C. Trzyna, *Environmental Impact Requirements in the States,* prepared for the Office of Research and Monitoring, Environmental Protection Agency, re-

printed in Council on Environmental Quality, *102 Monitor,* Vol. 3, No. 3, April 1973, at 21 *et seq;* Gordon A. Enk, *Beyond NEPA: Criteria for Environmental Impact Review.* (Rensselaerville, N.Y.: The Institute of Man and Science, May 1973); Council on Environmental Quality, *Environmental Quality—The Third Annual Report of the Council on Environmental Quality* (1972); Center for California Public Affairs, *Survey of State Environmental Policy Acts* (February 1, 1973).

86. California Environmental Quality Act of 1970 (CEQA), Cal. Pub. Res. Code §§ 21000–21174 (Supp. 1972), *as amended* by Ch. 56, Statutes of 1974 (March 4, 1974); Connecticut Environmental Policy Act of 1973, Pub. Act 73–562, approved June 22, 1973 (effective Feb. 1, 1975), Conn. Gen. Stat. Ch. 439, § 22a–1 *et seq.* (Cum. Supp. 1974–1975) (*Note:* Connecticut is presently operating under Executive Order No. 16, October 14, 1972); IC 1971, 13–1–10, *added by* P.L. 98, 1972, Ind. Stat. Ann. § 35–5301 *et seq.* (Supp. 1971); Act 246, Sess. Laws of Hawaii (approved June 4, 1974), Hawaii Rev. Stat. Ch. 334 (1974) [*Note:* This law has not yet become fully effective; as of August 1, 1974, Hawaii was still operating under its corresponding Executive Order, Hawaii Executive Order of August 23, 1971]; Maryland Environmental Policy Act of 1973, Ch. 702, Md. Laws of 1973, 41 Ann. Code of Md. §§ 447–451 (Cum. Supp. 1973), and Ch. 703, Md. Laws of 1973 Natural Res. Art., Ann. Code of Md. § 1–301 *et seq.* (1974 Vol.); Ch. 781, Acts of 1972, Ann. Laws Mass. Ch. 30, §§ 61–62 (Cum. Supp. 1973), *as amended* by C. 257 of the Acts of 1974; Minnesota Environmental Policy Act of 1973, Ch. 412, Laws of 1973, Minn. Stat. Ann. Ch. 116D. (Cum. Supp. 1974); Montana Environmental Policy Act of 1971, Ch. 238, L. 1971, Rev. Code Mont. § 69–6501 *et seq.* (Cum. Supp. 1973); North Carolina Environmental Policy Act of 1971 (1971, c.1203, s.1), N.C. Gen. Stat. Ch. 113A (Cum. Supp. 1973); South Dakota Environmental Policy Act, SL 974, Ch. 245 (approved March 2, 1974), S.D. Comp. Laws 1967, Ch. 11–1A (Supp. 1974); Virginia Environmental Policy Act of 1973, Ch. 774, Laws of 1972 and Ch. 384, Laws of 1973 (approved March 15, 1973, Va. Code Ann. §§ 10–177 through 10–185 and §§ 10–17.107 through 10–17.112 (Supp. 1973); State Environmental Policy Act of 1971 (SEPA), Rev. Code Wash. Ch. 43.21C (Supp. 1973); and Wisconsin Environmental Policy Act of 1971, Ch. 274, Laws of 1971, *adding* Wisc. Stat. Ann. Ch. 1, § 1.11 *et seq.* (Cum. Supp. 1974–1975). See also Puerto Rico Environmental Policy Act, 12 Laws P.R. Ann. § 1121 *et seq.* (1970).

87. Michigan Executive Order 1971–10, as superseded by Michigan Executive Order 1973–9; New Jersey Executive Order No. 53 (October 5, 1973); and *Policy for the Environment,* adopted March 7, 1972 by the Texas Interagency Council on Natural Resources and the Environment. In New Jersey, recent court and legislative actions have mandated environmental assessments of major public projects such as the Sports Complex by the New Jersey Sports and Exposition Authority and the Governor Alfred E. Driscoll Expressway by the New Jersey Turnpike Authority. In addition, two major pieces of New Jersey environmental legislation have included provisions for environmental impact statements prior to the issuance of permits on major projects. Coastal Area Facility Review Act, P.L. 1973, Ch. 185 (approved June 20, 1973), N.J.S.A. 13:19–1 *et seq.* (Cum. Supp. 1974–1975), and the New Jersey Wetlands Act of 1970, Ch. 272, Laws of 1970, N.J.S.A. 13:9A–1 *et seq.* (Cum Supp. 1974–1975). for the Wetlands Act EIS requirements, see *New Jersey Wetlands Order,* New Jersey Department of Environmental Protection (April, 1972).

88. Arizona, Georgia, Nevada, Nebraska and Delaware have impact statement requirements for selected categories of state activities. See text, *infra.*

89. Arizona Game and Fish Commission Policy of July 2, 1971.
90. Ga. L. 1972–179 (March 10, 1972), Ga. Code Ann. Ch. 95A–1, § 241 (e)(1) (1973).
91. Ch. 311, Laws of 1971, 58 Nev. Rev Stat. Ch. 704 (1971).
92. Nebraska Department of Roads, *Department of Roads Action Plan* (1973).
93. Delaware Coastal Zone Act, Ch. 175, Vol. 58 Laws of Del. (June 28, 1971), *adding* 7 Del. Code Ann. § 7001 et seq. (Supp. 1973) and Delaware Wetlands Law of 1973, *adding* 7 Del. Code Ann. Ch. 66 (Supp. 1973).
94. New York City, Executive Order No. 87, October 18, 1973.
95. Ordinance 0–2–73 of the Council of the City of Bowie, Maryland, July 16, 1973.
96. *Suggested State Environmental Policy Act,* originally drafted at Second National Symposium on State Environmental Legislation, Arlington, Va. (April 10–12, 1973); see also Council of State Governments *1974 Suggested State Legislation* (Vol. 33). (Hereinafter referred to as *Model Act.*)
97. Ann. Laws Mass. Ch. 30, § 62 (Cum. Supp. 1973).
98. Michigan Executive Order 1973–9 (1973).
99. *Policy for the Environment,* at 2 (March 7, 1972), and Wisc. Stat. Ann. § 1.11(2)(c)(6) (Cum. Supp. 1974–1975).
100. Minn. Stat. Ann. § 116D.04(1)(f) and § 116D.04(1)(g) (Cum. Supp. 1974).
101. Cal. Pub. Res. Code § 21100(c) (Supp. 1972).
102. 41 Ann. Code of Md. § 451(a)(2) (Cum. Supp. 1973); Ann. Laws Mass. Ch. 30, § 62 (Cum. Supp. 1973); N.C. Gen. Stat. § 113A–4 (2)(c) (Cum. Supp. 1973); Va. Code Ann. § 10–17.108(3) (Supp. 1973); and *Model Act* § 5(b)(6) (1973).
103. *CEQ Guidelines* § 1500.8(a)(4), 38 *Fed. Reg.* 20054 (August 1, 1973).
104. Cal. Pub. Res. Code § 21100(g) (Supp. 1972) and *Model Act* § 5(b)(7) (1973).
105. Montana Environmental Quality Council, *Revised Guidelines for Environmental Impact Statements Required by the Montana Environmental Policy Act of 1971,* § 6(a)(9), September 19, 1973.
106. Conn. Pub. Act 73–562, § 2(c), approved June 22, 1973 (effective Feb. 1, 1975); Michigan Executive Order 1973–9 (1973); Minn. Stat. Ann. § 116D.04(1)(b) (Cum. Supp. 1974); Rev. Code Mont. § 69–6504(b)(2) (Cum. Supp. 1973); and Wisc. Stat. Ann. § 1.11(2) (c)(6) (Cum. Supp. 1974–1975).
107. Michigan Executive Order 1973–9 (1973).
108. *CEQ Guidelines* § 1500.8(a)(3)(ii), 38 *Fed. Reg.* 20553 (August 1, 1973).
109. See *CEQ Guidelines* § 1500.5(a)(2), 38 *Fed. Reg.* 20551 (August 1, 1973).
110. *Friends of Mammoth* v. *Board of Supervisors of Mono County,* 8 Cal. 3d 247, 104 Cal. Rptr. 16, 500 P.2d 1360, 4 ERC 1593, 2 ELR 20673 (1972), *mod.* 104 Cal. Rptr. 761, 502 P.2d 1049, 4 ERC 1705 (1972).
111. Cal. Pub. Res. Code §§ 21169–21170 (Supp. 1972).
112. Cal. Pub. Res. Code § 21171 (Supp. 1972).
113. Ann. Laws Mass. Ch. 30, § 62 (Cum. Supp. 1973).
114. Ann. Laws Mass. Ch. 30, § 62 (Cum. Supp. 1973), *as amended* by Acts of 1974, c.257, s.1 (1974).
115. Massachusetts Executive Office of Environmental Affairs, *Regulations to Create a Uniform System for the Preparation of Environmental Impact Reports,* § 2.4 (July 6, 1973); see also *Regulations to Implement G.L. C.30 s.62, as amended by C. 257 of the Acts of 1974,* prepared

by Charles W. Foster, Secretary, Executive Office of Environmental Affairs (Draft, June 20, 1974).

116. RCW, § 43.21C.030(2) (Supp. 1973).
117. Michigan Executive Order 1973–9 (1973); Montana Environmental Quality Council *Revised Guidelines for Environmental Impact Statements Required by the Montana Environmental Policy Act of 1971,* § 5(a)(2), September 19, 1973; and *Guidelines for the Implementation of the Wisconsin Environmental Policy Act,* at 2, issued by Governor's Executive Order No. 69 (December 1973).
118. N.C. Gen. Stat. § 113A–8 (Cum. Supp. 1973).
119. Holden Beach, North Carolina, Ordinance Requiring Environmental Impact Statements, dated July 11, 1972. See Trzyna, *Environmental Impact Requirements in the States, supra* note 85.
120. 41 Ann. Code of Md. § 449(A) (Cum. Supp. 1973).
121. Minn. Stat. Ann. § 116D.04(1) (Cum. Supp. 1974).
122. Texas, Interagency Council for Natural Resources and the Environment, *Policy for the Environment* 2 (March 7, 1972), and *Guidelines for Preparation and Review of Environmental Impact Statements for State-Supported Projects,* at 1, in *Environment for Tomorrow: The Texas Response* (January 1, 1973).
123. Va. Code Ann. § 10–17.107(b) (Supp. 1973).
124. IC 1971, 13–10, Pub. L. No. 98, § 6, approved February 25, 1972.
125. Cal. Pub. Res. Code § 21161 (Supp. 1972).
126. Hawaii Executive Order (August 23, 1971).
127. Ann. Laws Mass. Ch. 30, § 62 (Cum. Supp. 1973).
128. See Memorandum from former Governor Robert W. Scott to Heads of All State Agencies and Institutions, delegating review authority to the North Carolina Council on State Goals and Policy, February 9, 1972.
129. Conn. Pub. Act 73–562, § 8, approved June 22, 1973 (effective Feb. 1, 1975), and Michigan Executive Order 1973–9 (1973).
130. Va. Code Ann. § 10–17.110 (Supp. 1973).
131. Minn. Stat. Ann. § 116D.04(3) (Cum. Supp. 1974).
132. Minn. Stat. Ann. § 116D.04(9) (Cum. Supp. 1974).
133. 14 Cal. Admin. Code Ch. 3, *Guidelines for Implementation of the California Environmental Quality Act of 1970* (Register 73, No. 50–12–15–73), as amended by order of the Secretary for Resources, March 22, 1974.
134. Michigan Executive Order 1973–9 (1973).
135. North Carolina Department of Administration, *Implementation of the Environmental Policy Act of 1971* at 2, February 18, 1972.
136. Wisc. Stat. Ann. § 1.11(d) (Cum. Supp. 1974–1975).
137. Massachusetts Executive Office of Environmental Affairs, *Regulations to Create a Uniform System for the Preparation of Environmental Impact Reports,* § 7.3 (July 6, 1973).
138. Minnesota Environmental Quality Council, *Rules and Regulations for Environmental Impact Statements,* at 23–24 (April 4, 1974).
139. 14 Cal. Admin. Code Ch. 3, *Guidelines for Implementation of the California Environmental Quality Act of 1970* (Register 73, No. 50–12–15–73), § 15061(b) (1973).
140. *City of Roswell, N.M.* v. *New Mexico Water Quality Commission,* 4 ERC 1753, 3 ELR 20181 (N.M. Ct. of App. 1972).
141. *Albuquerque Journal,* Feb. 17, 1974, p. C–10.

APPENDIX

States With Environmental Impact Statement Requirements, August 1, 1974

States with Comprehensive Statutory Requirements

California

Statutory Source: California Environmental Quality Act of 1970, Cal. Pub. Res Code §§ 21000–21174 (Supp. 1972), *as amended* by Ch. 56, Statutes of 1974 (March 4, 1974).

Guidelines: 14 Cal. Admin. Code Ch. 3, *Guidelines for Implementation of the California Environmental Quality Act of 1970* (Register 73, No. 50—12–15–73), as amended by order of the Secretary for Resources, March 22, 1974. Guidelines are prepared by the Resources Agency of California.

State Contact*: Norman E. Hill, Special Assistant to the Secretary for Resources, The Resources Agency, 1414 Ninth St., Sacramento, California 95815 (Phone: 916–445–9134).

Connecticut

Statutory Source: Connecticut Environmental Policy Act of 1973, Pub. Act 73–562 (approved June 22, 1973). Conn. Gen. Stat. Ann. Ch. 439, § 22a–1 *et seq.* (Cum. Supp. 1974–1975) (effective February 1, 1975). (*Note:* Currently in effect is Connecticut Executive Order No. 16, issued by the Governor on October 14, 1972.)

Guidelines: New guidelines are being prepared by the Department of Environmental Protection. Currently in effect: "Draft Guidelines for the Implementation of Executive Order No. 16," transmitted to state agencies under Memorandum from the Governor, dated December 13, 1972.

State Contact: Mary Ann Massey, Assistant Director of Planning and Research, Department of Environmental Protection, State Office Building, Hartford, Connecticut 06115 (Phone: 203–566–4256).

*"State Contact" here refers to persons who have working knowledge of the state's environmental impact statement process.

Hawaii

Statutory Source: Act 246, Sess. Laws of Hawaii (approved June 4, 1974), Hawaii Rev. Stat. Ch. 334 (1974). [*Note:* The law has not yet become fully effective. As of August 1, 1974, Hawaii was still operating under its corresponding Executive Order, Hawaii Executive Order of August 23, 1971.]

Guidelines: New rules and regulations are being prepared by the Hawaii Environmental Quality Commission, and are scheduled to be completed by the end of 1974.

State Contact: Dr. Albert Tom, Chairman, Environmental Quality Commission, 550 Halekauwila St., Honolulu, Hawaii 96813 *or* Richard E. Marland, Director, Office of Environmental Quality Control, Office of the Governor, 550 Halekauwila St., Room 301, Honolulu, Hawaii 96813 (Phone: 808–548–6915).

Indiana

Statutory Source: IC 1971, 13–1–10, *added by* Pub. L. 98, 1972, Ind. Stat. Ann. § 35–5301 *et seq.* (Supp. 1971).

Guidelines: Official guidelines have not been implemented. Draft guidelines have been prepared by the Environmental Management Board.

State Contact: Ralph Pickard, Technical Secretary, Environmental Management Board, 1300 W. Michigan St., Indianapolis, Indiana 46206 (Phone: 317–633–4420).

Maryland

Statutory Source: Maryland Environmental Policy Act of 1973, Ch. 702, Md. Laws of 1973, 41 Ann. Code of Md. §§ 447–451 (Cum. Supp. 1973), and Ch. 703, Md. Laws of 1973, Natural Res. Art., Ann. Code of Md. § 1–301 *et seq.* (1974 Vol.).

Guidelines: "Revised Guidelines for Implementation of the Maryland Environmental Policy Act," issued by the Secretary of the Department of Natural Resources, June 15, 1974.

State Contact: Paul McKee, Assistant Secretary, Department of Natural Resources, Tawes State Office Building, Annapolis, Maryland 21404 (Phone: 301–267–5548).

Massachusetts

Statutory Source: Ch. 781, Acts of 1972, Ann. Laws Mass. Ch. 30, §§ 61–62. (Cum. Supp. 1973), *as amended* by Ch. 257 of the Acts of 1974.

Guidelines: "Regulations to Create a Uniform System for the Preparation of Environmental Impact Reports," dated July 6, 1973, as amended October 15, 1973, and as amended in draft form on June 20, 1974. Guidelines are prepared by the Executive Office of Environmental Affairs.

State Contact: Matthew B. Connolly, Jr., Chief Planner, Executive Office of Environmental Affairs, 18 Tremont St., Boston, Massachusetts 20408 (Phone: 617–727–7700).

Minnesota

Statutory Source: Minnesota Environmental Policy Act of 1973, Ch. 412, Laws of 1973, Minn. Stat. Ann. Ch. 116D (Cum. Supp. 1974).

Guidelines: "Rules and Regulations for Environmental Impact Statements," issued by the Minnesota Environmental Quality Council (April 4, 1974).

State Contact: John Mohr, Environmental Quality Council, Capitol Square Building, 559 Cedar St., St. Paul, Minnesota 55101 (Phone: 612–296–3985) *or* Michael R. DesParte, Manager, Environmental Analysis Program, Environmental Quality Council (Same address) (Phone: 612–296–2686).

Montana

Statutory Source: Montana Environmental Policy Act of 1971, Ch. 238, L. 1971, Rev. Code Mont. § 69–6501 *et seq.* (Cum. Supp. 1973).

Guidelines: Montana Environmental Quality Council, "Revised Guidelines for Environmental Impact Statements Required by the Montana Environmental Policy Act of 1971," issued September 19, 1973.

State Contact: Loren L. Bahls, Ph. D., Acting Director, Montana Environmental Quality Council, Capitol Station, Helena, Montana 59601 (Phone: 406–449–3742).

North Carolina

Statutory Source: North Carolina Environmental Policy Act of 1971 (1971, c. 1203, s. 1), N.C. Gen. Stat. Ch. 113A (Cum. Supp. 1973).

Guidelines: North Carolina Department of Administration, "Guidelines for the Implementation of the Environmental Policy Act of 1971," issued February 18, 1972.

State Contact: D. Keith Whitenight, Environmental Planning Coordinator, Department of Natural and Economic Resources, P.O. Box 27687, Raleigh, North Carolina 27611 (Phone: 919–829–3115).

South Dakota

Statutory Source: South Dakota Environmental Policy Act, SL 1974, Ch. 245 (approved March 2, 1974), S.D. Comp. Laws 1967 Ch. 11–1A (Supp. 1974).

Guidelines: Department of Environmental Protection (1974 Informal Guidelines).

State Contact: Dr. Allyn O. Lockner, South Dakota Department of Environmental Protection, Office Building No. 2, Room 415, Pierre, South Dakota 57501 (Phone: 605–224–3351).

Virginia

Statutory Source: Virginia Environmental Policy Act of 1973, Ch. 384, Laws of 1973 (approved March 15, 1973) and Ch. 774, Laws of 1972; Va. Code Ann. §§ 10–17.107 through 10–17.112, and §§ 10–177 through 10–186 (Supp. 1973).

Guidelines: *Procedures Manual for Environmental Impact Statements in the Commonwealth of Virginia,* issued by the Governor's Council on the Environment (December 1973).

State Contact: Susan T. Wilburn, Environmental Impact Statement Coordinator, Governor's Office, Council on the Environment, Eighth Street Office Building, Richmond, Virginia 23219 (Phone: 804–770–4500).

Washington

Statutory Source: State Environmental Policy Act of 1971, Rev. Code Wash. Ch. 43.21C (Supp. 1973). For State Highway Project Environmental Impact Report Requirements, see Rev. Code Wash. Ch. 47.04 (Supp. 1973).

Guidelines: Guidelines currently in use: "Guidelines for Implementation of the State Environmental Policy Act of 1971." Current guidelines were prepared by the Department of Ecology.

State Contact: Stephen B. Crane, State of Washington Council on Environmental Protection, No. 5 South Sound Center, Lacey, Washington 98504, *or* Peter R. Haskin, Environmental Review and Evaluation, Office of Planning and Program Development, State of Washington Department of Ecology, Olympia, Washington 98504 (Phone: 206–753–6890).

Wisconsin

Statutory Source: Wisconsin Environmental Policy Act of 1971, Ch. 274, Laws of 1971, adding Wisc. Stat. Ann. Ch. 1, § 1.11 *et seq.* (Cum. Supp. 1974–1975).

Guidelines: "Guidelines for the Implementation of the Wisconsin Environmental Policy Act," issued by Governor's Executive Order No. 69 (December 1973).

State Contact: Farnum Alston, Office of the Governor, State Capitol, Madison, Wisconsin 53703 (Phone: 608–266–2121).

Puerto Rico's EIS Requirements

Statutory Source: Puerto Rico Environmental Policy Act, 12 Laws P.R. Ann. § 1121 *et seq.* (1970).

Guidelines: "Guidelines for the Preparation, Evaluation and Use of Environmental Impact Statements," issued by the Environmental Quality Board on December 19, 1972.

Puerto Rico Contact: Carlos Jimenez Barber, Executive Director, Environmental Quality Board, 1550 Ponce de Leon Ave., 4th Fl., Santurce, Puerto Rico 09910 (Phone: 809–725–5140).

States With Comprehensive Executive or Administrative Orders

Michigan

Source: Michigan Executive Order 1971–10, as superseded by Michigan Executive Order 1973–9 (1973).

Guidelines: Interim Guidelines, prepared by the Environmental Review Board and issued June 24, 1974.

State Contact: Terry L. Yonker, Executive Secretary, Environmental Review Board, Department of Management and Budget, Lansing, Michigan 48913 (Phone: 517–373–0933).

New Jersey

Source: New Jersey Executive Order No. 53 (October 15, 1973).

Guidelines: "Guidelines for the Preparation of an Environmental Impact Statement," issued by the Office of the Commissioner, Department of Environmental Protection (1973).

State Contact: Alfred T. Guido, Special Assistant to the Commissioner—Office of Environmental Review, Department of Environmental Protection, P.O. Box 1390, Trenton, New Jersey 08625 (Phone: 609–292–2662).

Texas

Source: *Policy for the Environment,* adopted by the Interagency Council on Natural Resources and Environment on March 7, 1972, and published in "Environment for Tomorrow: The Texas Response."

Guidelines: Guidelines and procedures are contained in "Environment for Tomorrow: The Texas Response," prepared by the Office of the Governor, Division of Planning Coordination, January 1, 1973.

State Contact: Leon Wilhite, Office of the Governor, Division of Planning Coordination, Box 12428, Capitol Station, Austin, Texas 78711 (Phone: 512–475–6156).

States With Special or Limited EIS Requirements

Arizona

Source: Game and Fish Commission Policy of July 2, 1971.

Guidelines: Memorandum by the Arizona Game and Fish Commission, "Requirements for Environmental Impact Statements," issued June 9, 1971.

State Contact: Robert D. Curtis, Chief, Wildlife Planning and Development Division, Arizona Game and Fish Commission, 2222 W. Greenway Rd., Phoenix, Arizona 85023 (Phone: 602–942–3000).

Delaware

Source: Delaware Coastal Zone Act, Ch. 175, Vol. 58 Laws of Del. (June 28, 1971), *adding* 7 Del. Code Ann. § 7001 *et seq.* (Supp. 1973), and Delaware Wetlands Law of 1973, *adding* 7 Del. Code Ann. Ch. 66 (Supp. 1973).

Guidelines: 7 Del. Code Ann. Ch. 66, § 6604 (Supp. 1973), and "Permit Application Instructions and Forms and Information Material on Required Procedures for the Coastal Zone Act," prepared and published by the Delaware State Planning Office (1973).

State Contact: John Sherman, Coastal Zone Administrator, State of Delaware, Executive Department Planning Office, Dover, Delaware 19901 (Phone: 302–678–4271) *or* F. Michael Parkowski, Deputy Attorney General, Department of Natural Resources and Environmental Control, Division of Environmental Control, Dover, Delaware 19901 (Phone: 302–678–4636).

Nevada

Source: Ch. 311, Laws of 1971, 58 N.R.S. Ch. 704 (1971).

Guidelines: No guidelines have been issued.

State Contact: Roger S. Toundray, Director, Department of Human Resources, 308 N. Curry St., Carson City, Nevada 80701 (Phone: 702–885–4750).

Georgia

Source: Ga. L. 1972–179 (March 10, 1972), Ga. Code Ann. Ch. 95A–1, § 241(e)(1) (1973).

Guidelines: *Policy and Procedures Manual: State Tollway Authority,* prepared by Georgia's Tollway Administrator's Office (May 1972).

State Contact: David Garrity, Planning Division, Office of Planning and Budget, Executive Department, 270 Washington St., S.W., Atlanta, Georgia 30334 (Phone: 404–656–3890).

Nebraska

Source and Guidelines: Nebraska Department of Roads, *Department of Roads Action Plan* (1973).

State Contact: Robert O. Kuzelka, Comprehensive Planning Coordinator, Office of Planning and Programming, Box 94601, State Capitol, Lincoln, Nebraska 68509 (Phone: 402–471–2311).

New Jersey

Source: Coastal Area Facility Review Act, P.L. 1973, Ch. 185 (approved June 20, 1973), N.J.S.A. 13:19–1 *et seq.* (Cum. Supp. 1974–1975), and the New Jersey Wetlands Act of 1970, Ch. 272, Laws of 1970, N.J.S.A. 13:9A–1 *et seq.* (Cum. Supp. 1974–1975).

Guidelines: "Procedural Rules for the Administration of the Coastal Area Facility Review Act," Draft prepared by the Department of Environmental Protection dated 1974, and "New Jersey Wetlands Order: Basis and Background," issued by the New Jersey Department of Environmental Protection (April 1972).

State Contact: Alfred Guido, Special Assistant to the Commissioner, Office of Environmental Review, Department of Environmental Protection, P.O. Box 1390, Trenton, New Jersey 08625 (Phone: 609–292–2662).

City NEPA's

New York, New York

Source: Executive Order No. 87, October 18, 1973.

Guidelines: A "City Environmental Policy Executive Order Environmental Information Form" is utilized for environmental analysis. The Information Form was prepared by the City of New York Environmental Protection Administration in 1973.

Contact: Tom Rogers, Office of Environmental Impact, N.Y. Environmental Protection Administration of the City of New York, Room 2344, Municipal Building, New York, N.Y. 10007 (Phone: 212–566–4107).

Bowie, Maryland

Source and Guidelines: The Bowie, Maryland Environmental Policy and Impact Statement Ordinance, passed by the City Council of Bowie, Maryland on May 3, 1971, and Ordinance 0–2–73 of the City Council of Bowie, Maryland, Declaring an Environmental Policy and Providing for Environmental Impact Statements, passed July 16, 1973.

Contact: Judith Meany, Environmental Planner, City Hall, Bowie, Maryland 20715 (Phone: 301–262–7900).

CHAPTER 5

A Global Environment

International activity to protect the environment has mushroomed in the 1970's. In attempting to describe this burst of activity, our Annual Reports have discussed international efforts to address environmental problems and reported on the activities of other nations and various international organizations. There was no set pattern in our reports, because the issue was new and there were many new approaches to it.

But this year, with the second meeting of the Governing Council of the United Nations Environment Program (UNEP), an integrated global approach to international environmental affairs has begun to take shape. The meeting was the first to be held at the new permanent headquarters of UNEP in Nairobi, the Kenyan capital.* The location of the headquarters itself has symbolic importance: in Africa, not far from where archeologists have found the earliest traces of man, and in a developing country rather than one of the highly industrialized nations that usually come to mind when pollution and environmental problems are mentioned.

This global approach to environmental problems—as set forth in the Action Plan—was initiated at the United Nations Conference on the Human Environment held at Stockholm in 1972 (hereafter referred to as the Stockholm Conference).[1] It was further developed at the UN General Assembly in New York in 1972 [2] and at the first meeting of the UNEP Governing Council in Geneva in 1973.[3] Simultaneously, various institutional arrangements were being developed to implement the Action Plan. As might be expected of an effort designed to cope with the totality of global environmental problems, the Action Plan is very comprehensive. Therefore, at the second meeting of the Governing Council, certain "areas of concentration" were

*A glossary of abbreviations is appended to this chapter.

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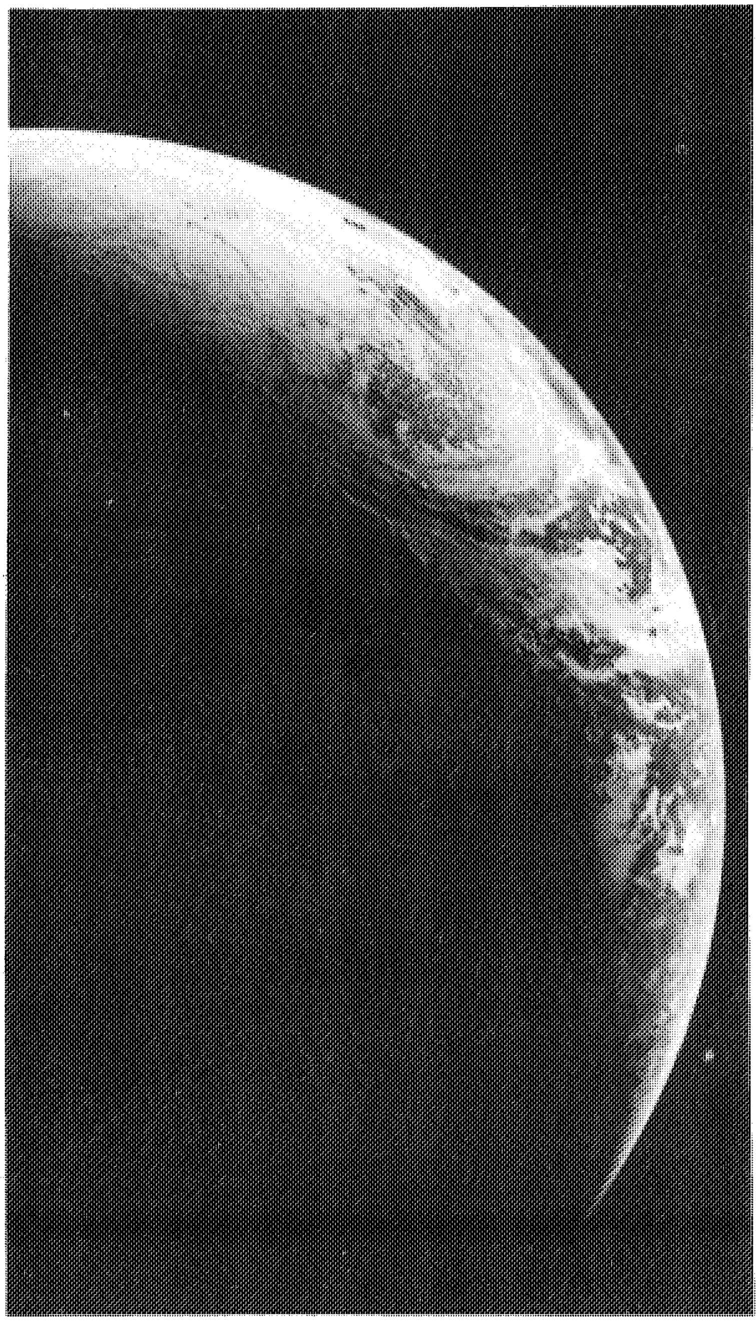


The fragile environment of our globe is illustrated in this dramatic photograph of the earth in crescent phase, taken from space.

identified, including specific programs to which funds and energies should be initially channeled.[4]

The Action Plan is a useful framework within which to discuss international environmental matters because it was developed not only to provide broad coordination of actions undertaken by UN agencies but also to recognize, stimulate, and coordinate actions of nations and those of other regional and international organizations.

This chapter describes the structure of environmental activities in the UN and discusses UN international activities in the framework of the Action Plan. The organizational chart of the UN system on the following page illustrates its complexity. The chapter concludes with a description of recent international activities undertaken outside that framework, principally bilateral.

The UN Environment Program and Environment Fund

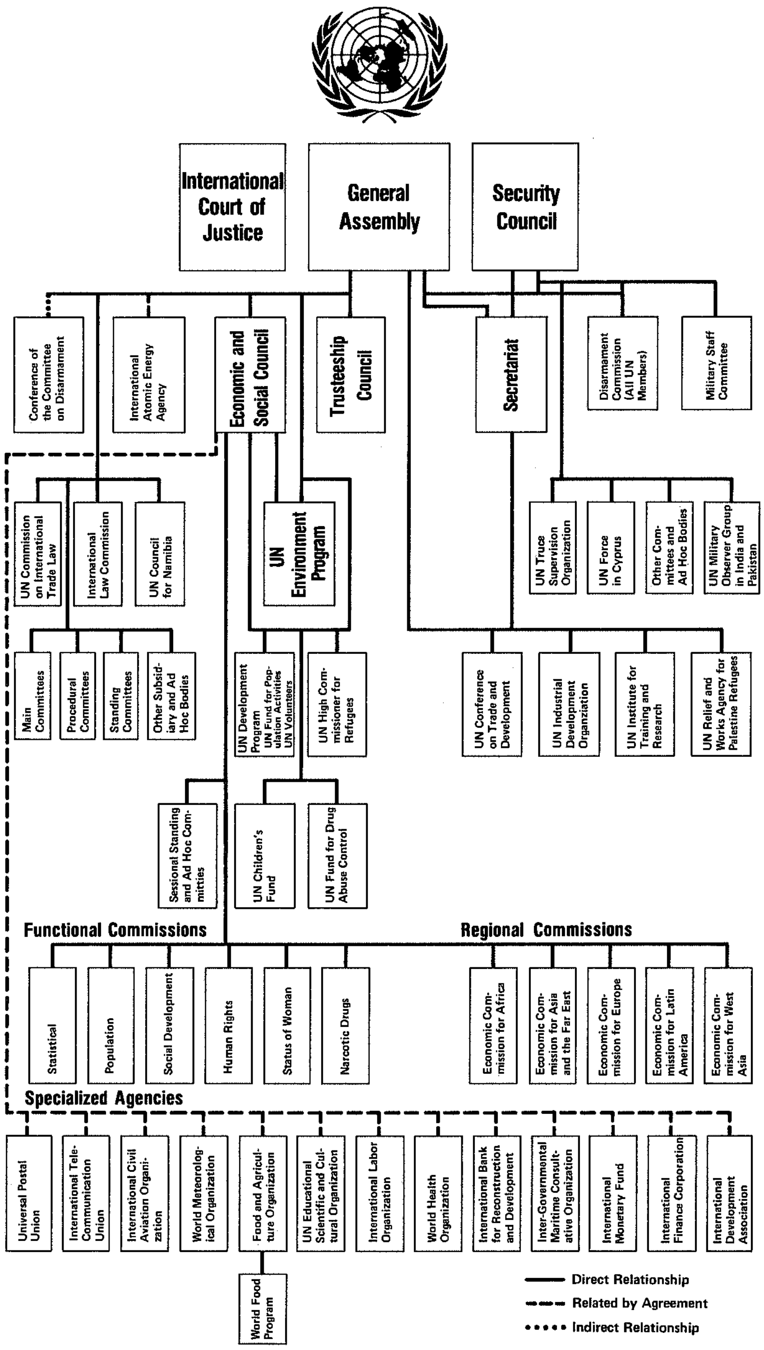
The Stockholm Conference recommended to the General Assembly that the environment be incorporated within the United Nations by the establishment of an administrative structure and an environmental fund. In December 1972, the General Assembly acted to create the Governing Council, the Environment Program Secretariat, the Environment Coordination Board, and the Environment Fund.

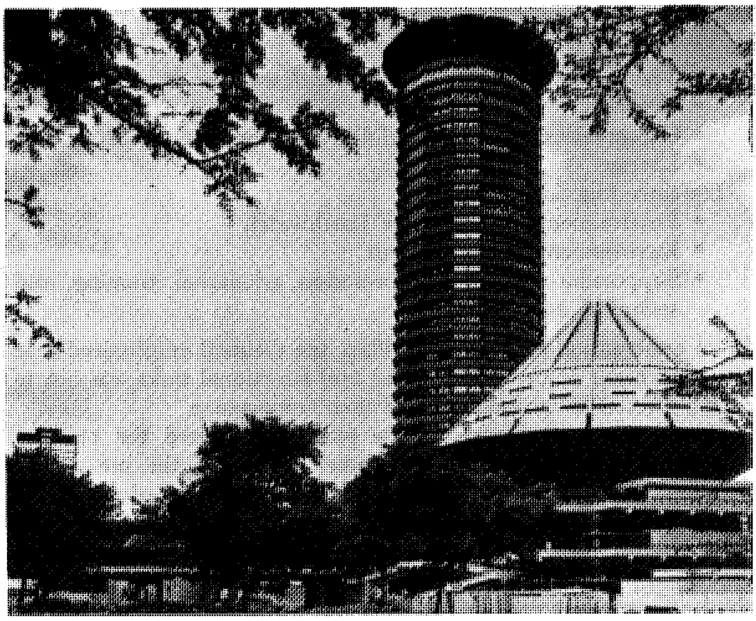
The main function of the Governing Council is to provide general policy guidance on the direction and coordination of environmental programs. The Council also supervises and promotes environmental programs and submits an annual report to the General Assembly through the Economic and Social Council.[5] The Governing Council is composed of 58 member nations, elected by the General Assembly for staggered 3-year terms. The present membership, drawn heavily from the developing nations, is made up of 16 states of Africa, 13 of Asia, 6 of Eastern Europe, 10 of Latin America, and 13 of Western Europe and elsewhere, including the United States.

The function of the Environment Program Secretariat is to coordinate environmental action within the UN system as well as to develop and support actions to fill gaps in a global environmental program. The Secretariat is headed by an Executive Director, elected for 4 years.[6] Maurice Strong, a Canadian who served as Secretary-General of the Stockholm Conference, was elected UNEP Executive Director by the General Assembly in December 1972. Establishment of Secretariat headquarters in Nairobi makes UNEP the first major UN body to have its seat in Africa.

The Environment Coordination Board (ECB) consists of representatives of the major UN agencies whose mission includes an environmental concern. It meets periodically to ensure cooperation

The United Nations System





The striking Jomo Kenyatta Conference Center in Nairobi, Kenya, where UNEP has its headquarters.

and coordination among all UN bodies with environmental programs. The Board reports to the Governing Council and is chaired by the UNEP Executive Director.[7]

The Environment Fund was established at the initiative of the United States to provide financing for international measures to protect and improve the environment.[8] Some $100 million has been pledged for five years. In 1973, $12.05 million was received, of which the United States contributed a major portion, $4.3 million. In 1974 UNEP expects to receive $20.7 million, of which the United States anticipates contributing $8.2 million, subject to Congressional action.[9]

Development of the Action Plan

The first session of the Governing Council, meeting in Geneva in June 1973, was concerned in part with administrative matters, such as defining its relationship with the Executive Director. In addition, with the active participation of the United States, the Council took significant steps in refining the Action Plan for the Environment, identifying six priority areas and three functional tasks on which UNEP was to center its activities. The six priority areas are:

- Human settlements, human health, habitat, and well-being
- Land, water, and desertification
- Trade, economics, technology, and transfer of technology
- Oceans
- Conservation of nature, wildlife, and genetic resources
- Energy

The three functional tasks are:

- Environmental assessment: Earthwatch
- Environmental management
- Supporting measures: information, education, training, and technical assistance

In an explanation of the Action Plan, the Council emphasized that the rank order of the priorities list and functional tasks was not to be interpreted as an indication of their importance.

The Council, in approving the plan, emphasized the primary role of UNEP as a coordinating mechanism and the use of the Environment Fund as a tool for achieving such coordination. It authorized the Secretariat to supply services for implementing the Convention on International Trade in Endangered Species and to give appropriate assistance in the preparation of other international conventions.[10] (Experience with the endangered species convention is discussed later in this chapter under "Conservation of Nature.") Recognizing the need for knowledge about the impact of man on his planet, the Council requested the Executive Director to explore the "possible outer limits to changes which man's activities may engender in some elements of the biosphere." [11]

The differences in philosophy between the developing and developed nations that emerged at the Stockholm Conference were evident also at the first session of the Governing Council. In the perception of developing countries, the major environment problems relate to the lack of economic development, and they want UNEP to concentrate on activities that relate to and support such development. The developed countries, in contrast, are more concerned about the impact of man on natural systems and want UNEP to play a major role in improving our knowledge of the global environment and coordinating efforts to manage and protect it. The Action Plan reflects the interests of both groups.

At the second session of the Governing Council in Nairobi in March 1974, decisions were made to guide the Executive Director in allocating resources into "areas of concentration" and specific programs within the structure of UNEP's Action Plan.[12] Programs approved included many on which the United States had placed high priority. Considerable attention centered about the establishment of a new International Habitat and Human Settlement Foundation (IHHSF), financed from the Environment Fund at $4,000,000 over four years, which will provide seed capital and technical assistance

for the improvement of human settlements. This effort was strongly supported by many developing countries.[13]

While developed and developing countries still held differing views on the nature of environmental problems, a consensus was achieved with respect to priorities and the use of the Environment Fund, based on a broad recognition that long-term economic development and sound environmental practices are inseparable.

Activities in Action Plan Subject Areas

The priority subject areas of the Action Plan provide a useful framework for describing the activities of UNEP and other UN agencies.

Human Settlements, Human Health, Habitat, and Well-Being— From the time of the earliest discussions of the UN environment program, many nations, particularly the developing nations, have felt that action in the area of human settlements, human health, habitat, and well-being should have the highest priority. Several of the areas of concentration chosen at the Second Governing Council meeting fall under this general heading.

The Governing Council directed UNEP to help governments improve the quality of life in rural and urban settlements. UNEP is also to help them understand and incorporate in their development planning the relationship between population factors, available resources, and the environment.

Numerous UN and other international agencies are working on various aspects of this priority. Indeed, as a UNEP report recognizes, "The exchange of information and experience concerning human settlements has been accorded high priority by the United Nations ever since 1946 . . ." As a result, there is "a substantial storehouse of information" available that should be utilized, and many activities of UN agencies currently center on this priority.[14] While this presentation can only touch on these activities, some mention of the highlights is useful.

Programs of UN and Other International Agencies[15]—The World Health Organization (WHO) will soon establish an International Reference Center for the environmental health aspects of urban planning and housing. It is advising governments on community water supplies and waste disposal facilities and is also defining environmental health criteria. WHO and the Food and Agriculture Organization (FAO) form the Codex Alimentarius Commission that is establishing international standards for pollutants in food and a code of ethics for the international food trade. The WHO and FAO are also working together on pesticides and food additives.

FAO is developing, with UNEP, a global research and training

program on integrated pest control. In this connection, FAO is active on the effects of pesticides and other agrochemicals.

UNEP is making a survey of existing data on potentially toxic substances in an effort to create an international toxic substances register. Some related work on a register has been done internationally, principally by two non-UN organizations, the Organization for Economic Cooperation and Development (OECD) and the European Atomic Community, now part of the European Communities (EC).

Other UN agencies working in the human settlements field are the World Meteorological Organization (WMO); the United Nations Educational, Scientific, and Cultural Organization (UNESCO), particularly through its Man and the Biosphere Program (MAB); the United Nations Children's Fund (UNICEF); the World Food Program (WFP); the United Nations Industrial Development Organization (UNIDO); and the International Atomic Energy Agency (IAEA).

The regional economic commissions—Economic Commission for Africa (ECA), Economic Commission for Asia and the Far East (ECAFE), Economic Commission for Europe (ECE), Economic Commission for Latin America (ECLA), and Economic Commission for West Asia (ECWA)—along with the UN Department of Economic and Social Affairs and other regional international organizations, sponsor important regional studies and seminars.

Major Conferences in the Area of Human Settlements—Several important conferences have been held or are being planned in this area.

1. *World Population Conference.* The UN General Assembly has designated 1974 as World Population Year (WPY). The WPY is part of an effort to achieve worldwide awareness of population matters and to find a rational, workable balance between people and resources, so that the quality of human life everywhere can be improved through better knowledge, informed policy and action.

The major event of WPY was the World Population Conference (WPC) in Bucharest in August 1974. Preparations included sym-

CEQ Chairman Russell W. Peterson meets with Romanian President Nicolae Ceausescu during the World Population Conference held in Bucharest. The president's interpreter is at the right.

posia on the relation of population to: development, natural resources, and environment; social and cultural aspects of family well-being; and human rights. In addition to these symposia, consultations were held with governments, and there were regional conferences in South Asia, the Middle East, the Far East, Africa, Europe, and Latin America to discuss drafts of the World Population Plan of Action.[16] This plan, issued by the conference, is designed to focus the world's attention on the population problem.

In its final form the plan states forthrightly that "all couples and individuals have the basic human right to decide freely and responsibly the number and spacing of their children and to have the information, education and means to do so; the responsibility of couples and individuals in the exercise of this right takes into account the needs of their living and future children, and their responsibilities towards the community." It follows this up by recommending to governments that they "consider making provision, in both their formal and nonformal educational programmes for informing their people of the consequences of existing or alternative fertility behaviour for the well-being of the family, the educational and psychological development of children and the general welfare of society, so that an informed and responsible attitude to marriage and reproduction will be promoted."

The plan recognizes that family planning programs are but a part of, though an essential part of, social and economic development and that these programs can assist social and economic development. Conversely, social and economic development can help moderate population fertility. Those sectors of development that accomplish this more effectively than others should have priority.

The plan emphasizes that the principal aim of social and economic development, including needed population policies, is to improve the quality of life of people. It goes beyond the draft versions of the plan in giving greater attention to the role of women in development and the need to take measures to improve their status. A specific goal of the plan is to reduce mortality levels, to the maximum extent possible, citing this as perhaps a prerequisite to a decline in fertility.

The plan notes that if birth rate projections in developing countries are to be reduced from the present 38 per thousand to 30 per thousand by 1985, "substantial national efforts" supported by adequate international assistance will be required. These projections assume that birth rates in the developed countries will remain at about 15 per thousand. The plan invites countries which consider their birth rates "detrimental to their national purposes" to consider "setting quantitative goals and implementing policies that may lead to the attainment of such goals by 1985." At the same time it acknowledges that each country has the sovereign right to set its own goals, or none at all.[17]

Secretary of Health, Education, and Welfare Caspar W. Weinberger, who headed the U.S. delegation to the conference, declared that

as a result of the conference, "We are all more aware of the nature of population factors in many countries and of the deeply held beliefs of our friends from these countries." He termed the entire conference "a real educational process for all those who have attended" and called the World Population Plan of Action "excellent . . . an accomplishment of great magnitude."

The United States consistently supported the convening of this conference and actively supported international activities dealing with population problems, both bilaterally through the Agency for International Development (AID) beginning in 1965, and multilaterally through the UN Fund for Population Activities (UNFPA) and the International Planned Parenthood Federation.[18]

2. *World Food Conference.* The World Food Conference was proposed by the U.S. Secretary of State before the UN General Assembly in September 1973. Noting that consumption of cereals has grown more rapidly than production since 1969, he proposed that the conference "discuss ways to maintain adequate food supplies and harness the efforts of all nations to meet the hunger and malnutrition resulting from natural disasters."[19]

In preparation for the conference, to be held in Rome in November 1974, several preliminary meetings have been held. A study of the current world food situation by the FAO was commissioned. The conference is expected to focus on increasing the production of food and improving its distribution in developing countries, setting up food reserves, and food aid.[20]

3. *UN Conference-Exposition on Human Settlements.* In December 1973, the UN General Assembly endorsed a recommendation of the Stockholm Conference and established a Conference-Exposition on Human Settlements to be held at Vancouver in May–June 1976.

The Conference-Exposition will discuss human needs in human settlements; human settlements and national development policy; planning and managing human settlements; international resources for human settlements; human settlements around the globe; and community technology and ecosystems. Visits to demonstration projects will also be encouraged.[21]

Land, Water, and Desertification—A section of the Action Plan is concerned with soil conservation, management and development of resources, water resources development, the prevention and abatement of water pollution, and countering desert expansion. At its second meeting, the Governing Council agreed on an eight-point program. The first priority is to be given to research on arid and semi-arid lands, with particular attention to the current drought in the Sudano-Sahelian region. Other items concern woodlands and forest ecosystems, soils, desert expansion, and water quality. Effective coordination of ongoing international programs is emphasized.[22]

Programs of UN and Other International Organizations—FAO, UNESCO, and WMO are the major UN agencies concerned with

land and water resources. The FAO conducts forest resource surveys and publishes a World Forest Inventory every five years. It holds symposia on forest management, including environmental forestry. In conjunction with UNEP, FAO is working on an international program for the ecological management of arid and semi-arid lands in Africa and the Near East. UNESCO is cooperating with UNEP to complete "state of knowledge" reports on major biomes.* In 1974, it held a meeting in Niamey, Niger, on ecological research; and it has studied humid tropical biomes in depth. WMO is studying the effects of man on weather and climate, both intentional (such as cloud seeding) and unintentional (such as emissions of carbon dioxide).

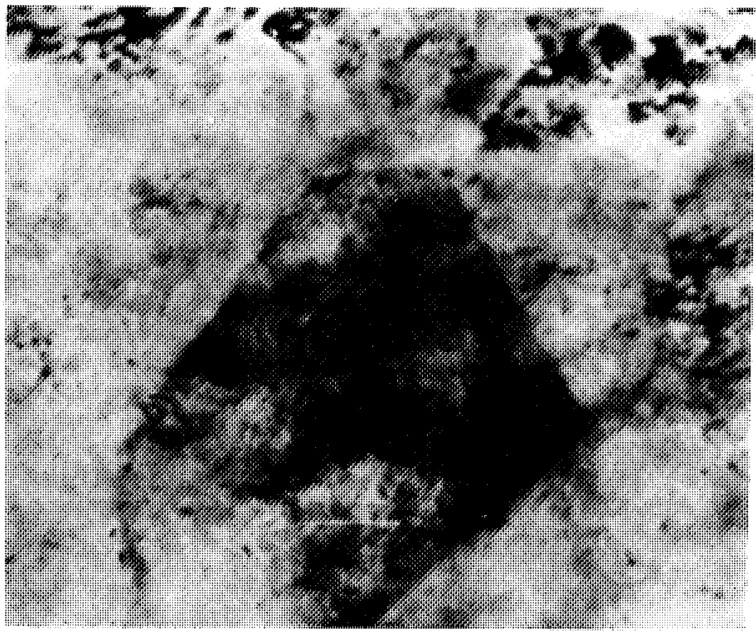
Among other water-related programs, UNEP has arranged for a global review of water resources and water quality. UNEP plans to cooperate with the International Atomic Energy Agency to conduct isotope studies of groundwater and surface water, with an emphasis on aquifers in arid lands, especially those south of the Sahara. More generally, UNEP assisted the First International Congress of Ecology held in The Hague in September 1974. UNEP is also supporting and encouraging meetings by specialized agencies, by groups of countries on a regional basis, or even by specific countries on all these related problems.[23]

The Sahelian Drought—Over the last year, world attention has been focused on drought in the Sahel, a strip of land stretching across Africa south of the Sahara Desert, between the desert itself and savanna country further south. Normal rainfall, which is seasonal, totals only 4 to 12 inches annually. For the past 5 to 6 years, perhaps longer in some sections, it has been much less. The drought-stricken area is as large as the continental United States, with a population of around 25 million, many of them nomads. Only in the past year have the enormity and consequences of the drought begun to be fully realized. The most seriously affected countries are Mauritania, Senegal, Mali, Niger, Upper Volta, and Chad. The drought has affected the Sudan and Ethiopia as well.

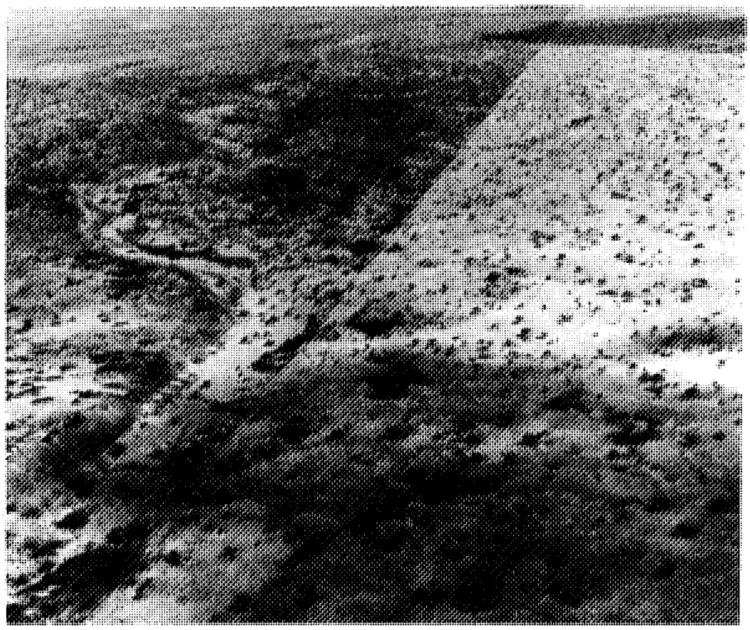
The World Food Program and the FAO began to plan emergency relief in 1972. In early 1973, the World Food Program, FAO, and UNEP sent study missions to survey livestock and water problems. In February 1973, the UN Economic Commission for Africa recommended that the Sahel governments declare the zone a disaster area. These governments, meeting in Upper Volta in March 1973, did so, and also set up a Permanent Interstate Committee on the Sahelian Drought. UNESCO and the UN General Assembly subsequently passed resolutions urging aid to these populations threatened with famine.

A special Office for the Sahelian Relief Operation (OSRO), estab-

*A biome is a distinct ecological unit such as grasslands, tropical forests, or tundra, which occurs widely and in different parts of the globe, and which is distinguished by similar plant and animal forms.



The dark area on this ERTS satellite (top) photograph of the Sahel, when viewed from an airplane, proved to be a carefully managed ranch in Niger, surviving the drought better than the surrounding area (bottom).



lished by the UN Secretary General, has been coordinating aid to the affected peoples. In June 1973, the Governing Councils of UNEP, UNDP, and FAO, and the Executive Committee of the Economic Commission for Africa, met to consider medium- and long-term measures to help provide recovery and rehabilitation.[24]

The Sahel is a prime example of a fragile environment which, if badly managed, can cease to support the people dependent upon it. As with many other fragile environments, very little is known about the Sahel. This belt of Africa, however, seems to have been subject to periodic severe droughts for centuries. Historically the nomadic indigenous peoples were able to range over the entire belt, moving from one area to another as dry periods changed conditions and the production of grass. The creation of several nation-states has introduced artificial political boundaries into this zone, thereby restricting nomadic movements. It is no longer as easy to wander in search of pastures not affected by the drought. This new restriction on movement, coupled with population growth stemming from the introduction of better health care, has meant that the current drought is causing greater ecological damage. Attempts to alleviate drought conditions by drilling wells have been counterproductive. Nomads have understandably concentrated their flocks around wellheads, destroying vegetation in the immediate surroundings, and thus advancing the encroachment of the desert.

Can the land recover? Better land management may provide an answer. One photograph taken by satellite pinpointed an area that was surviving the drought better than its surroundings. Located in Niger, it proved to be a fenced-off state-owned ranch, run according to modern range management principles.

UNEP can make a major contribution in the Sahel, both in coordinating medium- and long-term efforts of various international agencies and in organizing research and monitoring to learn more about the environment. The United States has played and will continue to play a large role in efforts to improve conditions in the Sahel, both by providing emergency relief and by extending technical assistance as, for example, through the Earth Resources Technology Satellite (ERTS) program of the National Aeronautics and Space Administration. The United States has been the largest single nation donor to the Sahelian states, its emergency assistance to date totaling $129 million, including 506,000 metric tons of food grain. Additional funding, including long-term assistance projects, has been approved by Congress.[25]

Trade, Economics, Technology and Transfer of Technology— The UNEP Governing Council at the Nairobi meeting voted to designate "trade, economics, technology and transfer of technology" a third area of concentration of UNEP resources. At this meeting, the Council proposed that the Executive Director develop a new format for the consideration of program activities in this

area. It gave highest priority to the development and transfer of environmentally sound technologies and to the analysis of the socio-economic impact of environmental measures, including the need for increased capital assistance to facilitate the introduction of environmentally sound technologies into the developing countries. The Council also recommended the development of guidelines for integrating environmental dimensions into development projects, the identification of industries which may have a comparative advantage for developing countries because of environmental considerations, and the development of an early warning system to enable prior consultations to take place on the adoption of new environmental measures which might relate to trade.[26]

In this area of concentration, UNEP must seek to coordinate environmental efforts not only within the United Nations family. It must also coordinate such efforts by organizations such as the Organization for Economic Cooperation and Development (OECD) and others concerned with the trade position of the developing countries.

Programs of UN and Other International Agencies—The United Nations Conference on Trade and Development (UNCTAD) is concerned with the expansion and diversification of the export trade of developing countries in manufactured and semi-manufactured goods. UNCTAD analyzes the effects of non-tariff barriers on these exports and is working with UNEP in studying trade barriers and restrictions resulting from environmental policies. On the basis of this study, UNEP plans to assist developing countries in assessing trade opportunities or risks arising from environmental regulation in the developed countries. This study may also provide the basis for an "early warning" system to alert nations to environmental measures that may affect trade, such as the prohibition of the use of vinyl chloride as a propellant or the use of nonreturnable containers. UNCTAD is assisting UNEP in preparing a meeting on the rational use of earth resources, and is initiating research on pollution caused by synthetic products for which there are natural alternatives.

Among its other environment-related projects, the United Nations Industrial Development Organization (UNIDO) has been studying materials flow in several industrial processes to identify materials required as inputs and those that are wastes. The goal is to create integrated industrial complexes that will conserve raw materials by utilizing each other's wastes.

GATT has catalogued and studied 27 categories of non-tariff barriers to international trade. It established a working group dealing with environmental and trade measures to which specific complaints may be submitted.[27]

The regional economic commissions, particularly ECLA and ECE, have also been active environmentally. ECLA is studying the con-

sequences for Latin America of environmental policies adopted by developed countries. The ECE is studying such matters as environmental problems in the energy field, control of emissions from specific industries, and control of discharges of toxic chemicals and wastes. It has analyzed the effects of environmental policies on trade and is also concerned with the impact of the energy crisis on environmental policies. The ECE Senior Environmental Advisors held their second session in Geneva in February 1974 and are well on their way to institutionalizing environmental concern in various ECE bodies. They will be sponsoring a seminar in April 1975 on ecological considerations in industrial development.[28]

The Organization for Economic Cooperation and Development consists of the major industrialized countries of Western Europe and North America plus Japan, Australia, and New Zealand. Earlier Annual Reports have discussed the OECD's Guiding Principles to secure compatibility of national environmental standards, particularly the "polluter pays" principle.

The OECD's Environmental Committee held its tenth session in Paris in March 1974. Energy was a major topic. The Committee plans to increase its knowledge of climatic impacts of electricity generation; environmental effects of recycling and its costs; the environmental effects of coal extraction and use; effects of offshore oil and gas developments; and standards for the siting of oil refineries and power plants.[29] Working in conjunction with other appropriate OECD organizations, it can be expected to devote greater attention to the specific environmental effects of various alternatives to energy generation.

Oceans—The urgency of UNEP action in the fourth area of the Action Plan—the preservation and protection of the seas—is well understood. At the Nairobi meeting, the Governing Council concluded that UNEP should concentrate on the coordination of activities of other agencies and give priority to regional efforts to protect endangered seas such as the Mediterranean, the Baltic, and the Caribbean; make a constructive contribution to the third United Nations Conference on the Law of the Sea; and promote the study, conservation, and wise management of living resources, including whales and other marine mammals.[30]

Programs of UN and Other International Agencies—The World Meteorological Organization (WMO) is coordinating studies on the movement of surface pollutants and on standardizing the methods of observation and analysis for monitoring marine pollution. It is also studying the atmospheric transport of pollutants from the land to the sea.

The International Atomic Energy Agency (IAEA) will study the effects of radioactive waste on the marine environment and work with UNEP on a symposium on the release of radioactive effluents

into the aquatic environment. Under the 1972 Ocean Dumping Convention, it is also responsible for identifying high-level radioactive wastes unsuitable for dumping and formulating recommendations on the issuing of special permits for other radioactive wastes.

The Intergovernmental Oceanographic Commission (IOC), with assistance from members of the UN system, is preparing a comprehensive plan for the Global Investigation of Pollution in the Marine Environment (GIPME), which will review the flow of water carrying dissolved and suspended substances from rivers to the oceans, including subsequent effects, and study land-based marine pollution.

The joint working group on River Inputs to Ocean Systems (RIOS), which UNEP supports, is reviewing the present state of knowledge. This group's work is related to that of the International Hydrological Decade (IHD). Working through UNESCO, UNEP is trying to develop a register of clean rivers.

FAO has been very active in the conservation, protection, and development of living aquatic resources through its Intergovernmental Committee on Fisheries (COFI) and regional and functional fishery bodies. The FAO Advisory Committee on Marine Resources Research (ACMRR) is studying the impact of pollution on aquatic resources. It also has a working party on marine mammals to examine and report on the identity, distribution, and stock of marine mammals which are exploited by man or otherwise affected by human activities. The FAO Fisheries Data Center is developing a program for determining the levels of contaminants in aquatic organisms.[31]

Whales—Whales, more than any other form of life, have come to symbolize the problems of managing and protecting living resources. The actions of the whaling nations since the Stockholm Conference have heightened international concern with the survival of whales. All eight species of great whales were placed on the Endangered Species List by the U.S. Secretary of the Interior in 1970. At U.S. initiative, a recommendation for a 10-year moratorium on commercial whaling was placed on the agenda for the Stockholm Conference, where it was passed overwhelmingly. However, this recommendation was rejected by the International Whaling Commission (IWC), the body established by international convention to regulate world whaling. A variety of conservation measures sought by the United States have also been rejected by the annual meetings of the IWC.[32]

In 1973 the IWC agreed on (1) a moratorium on the Antarctic fin whale beginning in 1976; (2) a provision to halt the overharvesting of sperm whales in certain areas in the southern hemisphere; and (3) another provision to establish a catch quota for minke whales. Japan and the Soviet Union, which together take over 80 percent of the world whale catch, repudiated these provisions. According to IWC regulations, if a country objects to a provision, it is not bound by that provision until it withdraws its

objection. Japan and the Soviet Union thus rejected the views of the other IWC members and the strong recommendations of the IWC Scientific Advisory Committee. The United States lodged strong protests with both nations.

The lack of responsiveness of Japan and the USSR to clear-cut international conservation needs led many leading U.S. citizen conservation organizations to declare a boycott of goods imported from those two countries. In large part due to the conservation advocacy of such citizen groups here and abroad, a series of important conservation measures was agreed upon at the 1974 IWC meeting. These included an automatic moratorium applying to any stock of whales which falls below optimum levels; agreement to manage whales by stocks, rather than setting quotas by oceans as a whole; significant reductions in quotas for fin and sei whales; and agreement to revise the existing, outdated whaling convention.[33]

However, the United States remains very concerned over the inadequate scientific information base as well as many other features of international whale management and conservation, and will continue to seek stronger and more effective measures. This incident demonstrates one of the roadblocks preventing international cooperation for protection of the environment—the competing interests of sovereign nations which may lead them to disregard the decisions of international bodies.

Regional Marine Activities—The past year has brought a number of international agreements and other efforts to provide protection for international waters threatened by pollution. A Convention on Fishing and Conservation of the Living Resources in the Baltic Sea and the Belts was agreed upon in Gdansk in September 1973.[34] A Convention for the Protection of the Baltic Sea from Pollution was signed in Helsinki in March 1974 by representatives of all the countries with Baltic coastlines.[35]

A conference of 15 West European governments, convened in Paris on the initiative of the French Government, in September and December 1973 adopted a Convention for the Prevention of Marine Pollution from Land-Based Sources. This convention is to protect the Northeast Atlantic from pollution through direct discharges or by way of rivers which flow through the territories of the signatories. After ratification, a commission is to be established to ensure observance of the terms of the convention.[36]

The International Council for the Exploration of the Sea is studying pollution in the Baltic and North Seas, and the Baltic and the Black Seas have both been discussed at ECE Senior Environmental Advisors meetings.

In the Mediterranean, the Inter-Parliamentary Union, with UNEP support, sponsored an inter-parliamentary conference on control of pollution. UNEP, jointly with IOC, is organizing a workshop to review pollution research programs and provide guidance for pilot

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programs, among other activities. An intergovernmental consultation, under FAO auspices, discussed the principles to be observed in order to protect fisheries and other living aquatic resources from pollution in the Mediterranean.

For the Caribbean Sea, the IOC and the FAO are preparing, with UNEP support, a workshop in 1975 to evaluate pollution there, including its effect on fishery resources, and to develop a pilot project for marine pollution monitoring. In another threatened marine environment, the Persian Gulf, Kuwait has convened a regional conference on water pollution to consider the environmental situation and ways and means to protect it from further pollution.

IMCO Conference on Marine Pollution—The Conference on Marine Pollution, organized by the Inter-Governmental Maritime Consultative Organization (IMCO) and held in London in October 1973, culminated in an International Convention for the Prevention of Pollution from Ships. It also agreed to a Protocol Relating to Intervention on the High Seas in Cases of Marine Pollution by Substances Other than Oil, and adopted a number of resolutions urging further studies on scientific and technical problems to implement and improve the convention, as well as the prevention and control of marine pollution.

The need for these measures is evident, for some estimates attribute 20 percent of sea pollution to ships, most of it from oil tankers. Earlier attempts to regulate this source of marine pollution were not entirely effective. An important achievement of the Conference was to include the so-called "white" oils (light refined petroleum products) as well as the "black" crude and residual oils. Also, more than 400 dangerous liquid cargoes other than oil, such as various chemicals, are to be regulated for the first time.

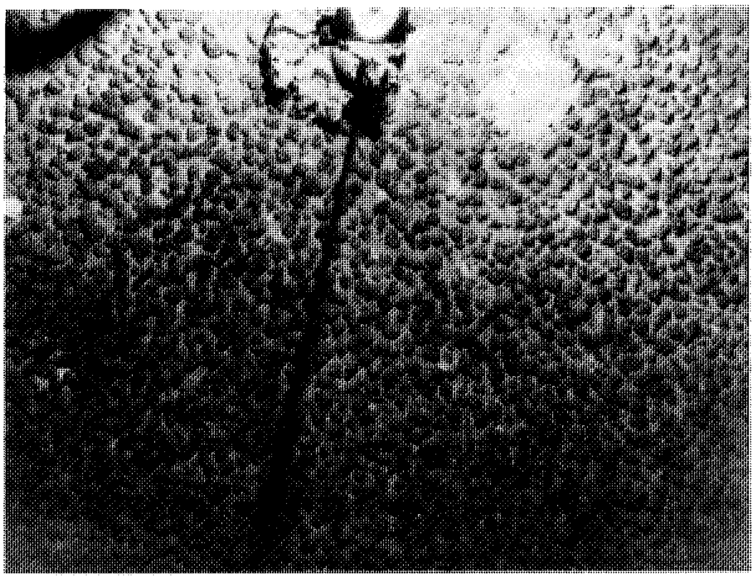
The major achievement of the Conference was to end the practice of large-scale discharge of oily water ballast from tankers. Tankers carry oil one way, and ballast cargo tanks with seawater for the return trip. In the past this seawater, mixed with oil residues from the cargo tanks, was discharged directly into the ocean. This is no longer allowed, except within very minimal limits—1/15,000 of the cargo for existing ships, 1/30,000 for new tankers—and that no closer than 50 miles to land. No discharges at all are to be allowed in the heavily polluted Mediterranean, Baltic, Black, and Red Seas and the Persian Gulf. It will also be necessary for new tankers of more than 70,000 dead weight tons contracted for after December 31, 1975, or for delivery after December 31, 1979, to have segregated ballast tanks so that oily cargo tanks are not routinely filled with ballast water.

To oversee the new regulations and propose amendments to them, IMCO created the Marine Environment Protection Committee (MEPC), which held its first meeting in London in March 1974. The MEPC will work towards the control and elimination of pollution of the seas from ships.[37]

While the Convention represents an important forward step, it will not enter into force for several years. And not all technical loopholes have been closed. For example, the United States and the Soviet Union urged that double bottoms be required for oil tankers, but this idea was not accepted. There are unanswered jurisdictional questions, such as whether the new IMCO standards will preempt stricter coastal state standards, and whether port states will be able to punish violations occurring on the high seas. Other jurisdictional problems are expected to be considered by the Law of the Sea Conference.

The Law of the Sea Conference—The environmental significance of this UN-sponsored conference, held in Caracas this summer, cannot be overemphasized. This was the third such conference, following two in Geneva in 1958 and in 1960. A major issue at the first conferences was that of national jurisdiction over the continental shelf, where oil was beginning to be exploited. A Convention on the Continental Shelf was adopted, as well as related conventions on the territorial sea and the contiguous zone, and on the high seas. Some of these conventions were ratified by enough nations to make them recognized as a part of international law; others were not.

The 1974 Conference was a response to still further technological advances which have rendered the traditional law of the sea obsolete in many respects. By the late 1960's, new technology was being developed for exploitation of mineral resources on the deep seabed, in



Nodules containing manganese, copper, cobalt, and nickel litter the deep sea floor in certain areas of the oceans. Their exploitation was one of many subjects discussed at the Law of the Sea Conference in Caracas, Venezuela.

particular the manganese/cobalt/nickel/copper nodules found in many ocean regions. In 1968 the UN General Assembly created a Seabeds Committee to consider issues concerning these deep sea deposits. The committee soon realized that the law of the sea issues transcended the question of exploitation: ambiguities and unsettled questions arising under the 1958 conventions had become very troublesome; differing claims were being made concerning territorial waters; and long-distance fishing fleets were exploiting fisheries far from their own lands but close to other countries.

In December 1970, the UN General Assembly passed a resolution requesting the UN Secretary General to study deep seabed mineral production and the question of landlocked nations' access to the sea, and also to convene a Conference on the Law of the Sea. This conference was to seek to develop an equitable international regime for the seabed beyond the limits of national jurisdiction and a precise definition of the area. The conference was also to consider related issues concerning the high seas, the continental shelf, the territorial sea and contiguous zone, including international straits; fishing and conservation of the living resources of the high seas; the preservation of the marine environment; and scientific research.[38]

Nearly 150 nations participated in the 1974 session of the conference in Caracas. While a consensus emerged that world community interests would be best served by an acceptable and timely treaty, several critical issues remain to be resolved. For instance, there was general agreement on the breadth of the territorial sea and adjacent economic zone; but the precise nature of coastal state jurisdiction within such areas—including environmental and conservation obligations concerning resource activities, and rights, if any, over vessel-source pollution—has not been fully determined. Moreover, differences still exist concerning the regime to govern exploration and exploitation of the deep seabed. After 10 weeks of negotiations, the conference adjourned until March 1975, when it will resume in Geneva.

The outcome of the Law of the Sea negotiations remains as important as ever. An environmentally acceptable result could complement IMCO efforts to clean up ship pollution, contribute to environmentally sound use of seabed resources and also to conservation of fish stocks. Alternatively, a conclusion which does not take international environmental realities into account could possibly bring our globe closer to those "limits" that the UNEP Secretary is now exploring.

Conservation of Nature, Wildlife, and Genetic Resources— Representatives of several developing countries played a leadership role in initiating action at the second Governing Council meeting to include within the selected areas of concentration "conservation of wetlands and of waterfowl and other migratory species" as well as adding a recommendation for the expansion of national parks

systems. Nations are beginning to recognize that the conservation of wildlife is more than just a nostalgic impulse and that the conservation of nature means the conservation of man as well. A world which relies on single genetic strains for production of food and fiber commodities is increasingly susceptible to unexpected plagues and blights. U.S. loss in 1970 of millions of bushels of vulnerable hybrid corn due to the corn-leaf blight is a frightening example. Genetic reserves—such as stores of viable seeds of different strains of the same plant—can make possible the continuing development of multiple domesticated strains and assure survival of plants and animals. And man's recreational needs, often fulfilled in communion with nature, cannot be ignored.

Up to now very few intergovernmental international organizations have had programs concerning the conservation of nature, wildlife, and genetic resources. The Governing Council, following the lead of the United States, decided upon ambitious objectives in this priority area, resolving (1) that UNEP should give particular attention to the protection of endangered species of fauna and flora; (2) that efforts should be made to expand the network of terrestrial and marine parks, and to preserve aquatic and terrestrial ecosystems, biomes, and habitats; and (3) that the preservation of the diversity of genetic resources should be one of UNEP's most important objectives.[39]

Work of UN and Other International Organizations—The conservation of nature, wildlife and genetic resources is an area where UNEP's initiating role, as distinguished from its coordinating role, could be put to effective use. Few UN agencies are concentrating in this area at this point. Notable among these few is FAO, which is developing programs to: (1) exchange data on the inventory and utilization of wildlife resources; and (2) assess the potential of outdoor recreation, including the economic and environmental impact of tourism. FAO's Regional Forestry Commissions are planning a network of national parks, game reserves, and forest recreation areas. Its Consultative Group on International Agricultural Research has recommended the establishment of a global network of genetic resources centers and last fall created an International Board of Plant Genetic Resources.

UNESCO has also led several environment-related projects, including one which is to survey natural areas and then define the criteria and ways and means for the establishment of an adequate network of protected areas and biosphere reserves.[40]

The most active international organization concerned with the conservation of nature, wildlife, and genetic resources has been the International Union for Conservation of Nature and Natural Resources (IUCN), founded in 1948. It is an independent international organization whose members include sovereign states, governmental and private organizations, and international groups. More

than 70 nations are represented. While IUCN is not a UN organization, it enjoys the support of and consultative status with UN agencies, particularly UNESCO, FAO, and ECOSOC. The IUCN operates through a number of commissions and committees: the Survival Service Commission, which works to prevent the extermination of endangered species; the Commission on Education; the Commission on Ecology, which is the primary IUCN scientific advisory body; the International Commission on National Parks; the Commission on Environmental Policy, Law, and Administration; and the Commission on Landscape Planning.[41]

Given the IUCN's prominence in this field, the UNEP has turned to it for assistance in several areas. At its first meeting, UNEP's Governing Council directed its Secretariat to supply secretarial functions related to the Convention on International Trade in Endangered Species of Wild Fauna and Flora. The UNEP Executive Director arranged with IUCN to provide the needed secretarial functions.

UNEP in turn has aided several IUCN projects assessing the national park and reserve systems of East Africa and Latin America and their coverage of the ecosystems of those areas. Conferences will follow up on the recommendations.

UNEP will also support a 1975 conference on the establishment of parks and reserves in Southwest Asia and North and East Africa organized by IUCN and the World Wildlife Fund (WWF) and hosted by the Government of Iran. UNEP will collaborate with IUCN on an international conference organized by the Marine Parks Center of Japan to take place in Tokyo in May 1975.

Other IUCN work includes the establishment of a world directory of national parks and other protected areas and the creation of an ecological data bank. IUCN's International Commission on National Parks works with the UN to maintain a register of the world's national parks and equivalent reserves. It has also developed draft guidelines for the establishment of marine national parks and the classification of natural regions of the world into biotic provinces.

Relevant Conventions—Only a few multilateral international treaties or conventions concern the conservation of nature, wildlife, and genetic resources directly. The most important is the Convention on International Trade in Endangered Species of Wild Fauna and Flora, concluded in Washington in February 1973.[42] By June 1974, it had been signed by 44 nations and ratified by two. The United States was the first nation to ratify, on January 14, 1974.

As soon as 10 nations have ratified, the convention will come into force. A conference of ratifying nations will be convened as soon as possible thereafter, probably late in 1974 or early in 1975. Meetings are to be held at least once every 2 years to review the implementation of the convention and make recommendations to improve its effectiveness.

Another significant convention is that on the Protection of the World Cultural and Natural Heritage (World Heritage Trust), adopted by the UNESCO General Conference in November 1972. This convention, discussed in earlier Annual Reports, was the result of a U.S. initiative.[43] As of June 1974, four nations had acceded to this convention.

There has been little progress toward the ratification of the Convention for the Conservation of Antarctic Seals. U.S. ratification will depend upon the completion of the NEPA process. An environmental impact statement, now under preparation, will treat most U.S.-sponsored programs in the Antarctic. The convention itself is somewhat controversial, since some environmentalists feel that it might encourage the hunting of seal populations not now being exploited. The convention was drafted in the expectation that such exploitation would develop sooner or later, and that it should be regulated scientifically. Moreover, the Antarctic Treaty of 1959 neither prohibits nor regulates the taking of seals or other fauna on the high seas.[44]

Given the Governing Council's request to the Executive Director "to give assistance as appropriate in the preparation of other international conventions in the environment field," conventions will undoubtedly be added to this list to help protect the global environment.

Energy—With so many organizations involved in energy questions, the United States has not wished to see UNEP assign any considerable part of its limited resources to energy questions. Nevertheless, the Governing Council at the Nairobi meeting directed that UNEP should concentrate on the environmental consequences of energy generation and use, taking into account the results of the sixth Special Session of the General Assembly on the problems of raw materials and development. UNEP, the Council directed, should work in close cooperation with the appropriate UN bodies and the IAEA.[45]

Environmental Assessment: Earthwatch—Earthwatch is one of UNEP's major functional tasks. It is designed to provide a global environmental assessment so that decisions on the management of the environment are sound and rational. Earthwatch will help define the status of earth's environment and monitor changes in it through two distinct activities: the Global Environmental Monitoring System (GEMS), and the International Referral System for Sources of Environmental Information (IRS).[46] U.S. initiative has been important in the establishment of both these activities.

GEMS will be a global system composed of national and international facilities, services, and activities, coordinated—and in some cases supported—by UNEP. It will build upon elements already existing throughout the world, including the Integrated Global Ocean Station System; the Global Investigation of Pollution in the Marine

Environment; the WHO International Reference Centers; the International Hydrological Decade system of river stations; the World Appraisal of Fishery Resources; the World Forest Appraisal; the World Weather Watch; and the Global Atmospheric Research Program.

At an intergovernmental meeting on monitoring held in Nairobi in February 1974 to advise UNEP on Earthwatch, it was decided to expand the monitoring system to include not only the pollutants outlined by the Governing Council, but also other environmental and biotic factors that reflect the health of an ecosystem, such as the expansion of deserts.[47] UNEP has agreed to extend limited assistance to certain current pre-programming monitoring activities of various UN agencies, activities expected eventually to become parts of the future monitoring system. This assistance has included support to WHO and WMO projects on monitoring air pollution in developing countries, and to WHO, WMO, FAO, IAEA, and UNESCO for developing various pollution monitoring systems.

UNEP will continue to develop the International Referral System, which will serve to gather and disseminate environmental information throughout the world. Governments and intergovernmental organizations will be able to obtain information on matters such as the state of the environment; monitoring procedures; the evaluation of environmental factors; and control and management technologies. Meetings of experts have been held in London, Geneva, Heidelberg, and Nairobi to work on the design of a practical IRS system. Cooperative arrangements have already been made with a large number of organizations with a view to establishing a network of sources able to respond directly to users' questions.

Environmental Management—UNEP hopes "to encourage and support an integrated approach to the planning and management of development, including that of natural resources, so as to take account of environmental consequences, to achieve maximum social, economic and environmental benefits." [48] This means that the planning and management of natural resources should take account of the full range of environmental considerations. The Governing Council endorsed efforts along these lines, and suggested the establishment of a few pilot projects in developing countries. It also suggested convening a panel of experts to assist in the formulation of criteria for the evaluation of development projects.[49]

Various international agencies have shown concern for the integrated planning and management approach. UNESCO has used integrated surveys for some time, especially in its Arid Zone Research programs. It has established the International Training Center for Aerial Survey and Earth Resources at Enschede, The Netherlands, to develop the integrated concept through training and research. UNESCO organized a regional training course in tropical ecology in Venezuela last year. It has sponsored and supported postgraduate

courses, mostly for students from developing countries, at centers in the Netherlands, France, and England. Working with the UN Institute for Training and Research (UNITAR), it has also organized a seminar for decisionmakers. FAO and WHO have related programs. With the International Bank for Reconstruction and Development, WHO assists governments in conducting assessments of water and sewerage projects.

The Scientific Committee on the Problems of the Environment (SCOPE) of the ICSU has a working group on man-modified ecosystems, and plans to assist developing countries to identify major environmental problems at national or regional levels. UNEP assisted SCOPE with a workshop held in Canada in February 1974 on methods of assessing the environmental impacts of development. The two also sponsored a symposium on environmental sciences in the developing countries in Nairobi early in 1974. IUCN, cooperating with the World Wildlife Fund, has begun a project which, it is hoped, will demonstrate how economically viable, balanced ecosystems can be created in arid lands.

UNEP is extending technical assistance to ECLA for a survey of Latin American environmental problems and the capabilities—in terms of legislative authority, institutional machinery, and research ability—for addressing them. The survey will be used both in defining how UNEP can cooperate in Latin America on the diagnosis of environmental problems as related to economic development, and as a case study for determining how UNEP might extend the same cooperation in other areas of the world.

Supporting Measures—This section deals with various activities which functionally support all other elements of the UNEP program.[50] At its second meeting, the Governing Council emphasized the importance of these activities.[51]

Information—The IRS network was described earlier. Of primary importance, particularly in the developing countries, is the improvement of information-gathering systems within countries to assure a reliable exchange of information about local, national, and regional conditions. It also involves public information to "create awareness" and "increase consciousness and appreciation of environmental matters." UNEP has planned a variety of actions to work towards greater environmental awareness. It has already partially supported IUCN in a project to improve existing mechanisms for informing the public about environmental problems and increasing its awareness of them. UNEP is studying the establishment of an Environment Program Information Center which would provide material to the information services of governments, to national committees concerned with the environment, to educational systems at all levels, to channels of mass communications, and to nongovernmental organizations.

To focus world attention on the environment and celebrate the

Maurice Strong,
Executive Director of UNEP,
at Environment Day
ceremonies at the World's
Fair on the Environment
in Spokane.

anniversary of the Stockholm Conference, the UN proclaimed June 5 as World Environment Day. Complementing this, President Nixon issued a proclamation calling on Americans to observe the day. UNEP Executive Director Maurice Strong opened World Environment Day on June 5, 1974, at the World's Fair on the Environment (EXPO '74) in Spokane. There he briefly reviewed UNEP activities, warned of the dangers of the energy crisis, and expressed "hope in the growing number of positive examples of how the creative uses of technology combined with political will can indeed produce a better environment." [52]

Education and Training—UNEP is attempting to develop an international program of environmental education that will strike a balance between the education of ordinary citizens and the special training of those members of the general public who affect the environment through their professional activities. The Governing Council, at its second meeting, resolved that emphasis should be given to the preparation of textbooks, curricula, and teaching aids.

UNEP is now reviewing existing resources and capabilities as a prerequisite to formulating its program in education in environmental management and administration. It is cooperating in particular with UNESCO, which is knowledgeable about environmental education in many countries and possesses a growing collection of material on environmental education. UNEP is also working with the Center for International Studies of the University of Belgrade on a workshop on environmental education and training programs to be held this year.

UNEP will also support an International Congress on Environmental Education, organized by the IUCN and UNESCO, to be held late in 1974 or in 1975. The Congress will analyze trends and problems in environmental education and prepare a long-term cooperative international program in environmental education and training. A series of regional meetings for experts and specialists will complement the Congress. The UNEP Executive Director will also seek

to arrange support for training national cadres in key areas of environmental management through the strengthening of appropriate national and regional institutions.

Technical Assistance—As noted earlier, the role of UNEP is largely one of coordination rather than of direct involvement in technical assistance operations on the international scene. UNEP will act as a clearing house, helping those in need of assistance gain access to, and obtain assistance from, various other sources. It will also help to organize national and international efforts, with supplementary financial support or assistance as appropriate.

At its second meeting, the Governing Council further agreed that technical assistance should be directed toward strengthening national and regional capabilities in environmental protection, toward education and training and toward the development of appropriate environmental policies. It was also agreed that specific criteria for the provision of technical assistance should be developed, and UNEP is now working to develop a more precise policy.

Bilateral Cooperation

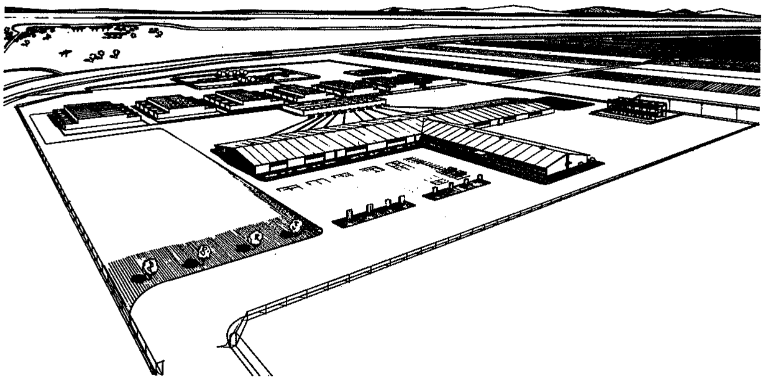
Thus far in the chapter, the United Nations Environment Program has been used as a framework for describing global and regional developments, and as a means of directing attention toward environmental problems more than toward institutions. But this form of presentation is not intended to indicate a change in U.S. environmental priorities or any lessening of U.S. interest in bilateral cooperative arrangements. During the past year, international cooperation on a bilateral basis expanded in a number of areas. New projects were undertaken with countries already active in cooperation with the United States, and projects were begun with countries which had not previously had specific environmental ties with us.

While only the highlights can be mentioned here, special notice should be taken of environmental relations with Canada and Mexico. Because of common frontiers and shared water resources, matters that are now considered environmental are part of the more traditional political relationships the United States has enjoyed with its neighbors.

Mexico

During the last year an environmental problem of great importance to Mexico and the United States moved toward resolution as the result of an agreement on August 30, 1973 on a "Permanent and Definitive Solution to the International Problems of the Salinity of the Colorado River." [53]

The agreement, which requires the approval of both governments,



Artist's conception of the desalting plant to be constructed near Yuma, Arizona, to improve the quality of Colorado River water delivered to Mexico.

provides for controlling the quality of Colorado River water used to irrigate land in the Mexicali Valley in Mexico. Under a 1944 treaty, the United States guaranteed Mexico 1.5 million acre-feet of water from the Colorado per year, but no mention of water quality was made. As various irrigation projects were developed on the U.S. side of the border, the return flow made Colorado River water more and more salty, so that crop production in Mexico was hindered. Under the new agreement, the United States will build a large desalting plant to control the quality of water delivered to Mexico. A lined channel will discharge the waste brine into the Santa Clara Slough in Mexico. This project has been authorized by the Congress and signed into law by the President.[54] Until it is completed, the saline irrigation return flow will be diverted and replaced by additional quantities of fresh water released from upstream dams.

Additional discussion of environmental problems along the border took place December 6–7, 1973, in Mexico City. Specific problems discussed included the effect on tourism in Mexico of U.S. limitations on quantity and quality of gasoline, and the consequences of increased tourism to the ecology of Baja California. Water quality in the Rio Grande and air pollution resulting from smelting were also considered.[55] The U.S. Department of the Interior stands ready to respond if Mexico requests cooperation in protecting Baja California. The International Boundary and Water Commission, made up of U.S. and Mexican representatives, serves as a useful forum for continuing, informal contacts on water pollution problems.

Canada

The United States and Canada are seeking mutually beneficial solutions to a number of environmental problems, ranging the length

of the border from Puget Sound to the waters off Maine and New Brunswick.

In coastal areas, as in the Arctic regions, the major concern is potential damage from oil spills. To cope with this threat, which will become potentially much more severe once oil from the trans-Alaska pipeline is transported along the Pacific Coast by tanker, the United States and Canada in June 1974 concluded a joint oil spill contingency plan covering the Atlantic and Pacific coasts as well as the Great Lakes.[56]

In the inland regions, the problems relate more to the development of water resources. For example, the proposed raising of the height of Ross Dam on the Skagit River in Washington has caused concern on the Canadian side over the eventual flooding of several square miles of the valley floor. The U.S. operator of the dam, the Seattle Light and Power Company, has expressed willingness to discuss with Canada ways of producing the power it needs which would be less harmful to the environment.

Positions are reversed along the Pembina River in North Dakota. Here citizens are concerned that levees built by private landowners in Manitoba have so confined the natural flood plain of the river as to intensify the danger of flood damage upstream on the U.S. side.

The major shared environmental problem remains the pollution of the Great Lakes. Both sides are making significant efforts to clean up the lakes in accordance with the Great Lakes Water Quality Agreement of 1972. In its 1973 annual report to the International Joint Commission, the Great Lakes Water Quality Board, while noting that "trends in water quality, except for a few specific areas, cannot be established with any degree of statistical certainty," concluded that "substantial progress" has been made toward attainment of the agreement's objectives and that U.S. and Canadian sewage treatment programs are adequate to achieve those objectives.[57]

Since 1972, a total of $4.4 billion in waste treatment grant authority has been provided to the eight Great Lakes states. EPA expects that construction will be initiated on sewage treatment projects for all major municipal discharges by December 1975. EPA planned to spend $6 million during fiscal year 1975 for research and related activities on the Great Lakes. An additional $3.5 million, however, was made available in May 1974.[58] These funds are intended to support joint U.S.-Canadian water quality investigations under the Great Lakes Water Quality Agreement. One goal of the studies is to evaluate the present quality of Lake Superior and Lake Huron and make recommendations regarding the prevention and control of pollution of those lakes. A second goal is to determine to what extent pollution in the Great Lakes system is caused by runoff from agriculture, forestry, and other land use activities.

Another environmental problem between the United States and Canada is the Bureau of Reclamation's Garrison Diversion Unit in

North Dakota. Under this project, the Bureau proposes to divert large quantities of water from the Missouri River to irrigate, in the initial stage, 250,000 acres of land in north central and eastern North Dakota. Much of the land proposed for irrigation under the present project design lies in the watersheds of the Souris and Red Rivers, which flow into Canada.[59]

U.S. environmentalists have registered strong opposition to the project's potential effects on fish and wildlife and prairie wetlands ecology. In Canada, the prospect that return flows from irrigation in the United States will greatly increase the salinity of these rivers has aroused considerable concern. In October 1973, the Canadian Government requested a moratorium on further construction of the Garrison Diversion Unit until the two governments could reach an understanding "that the Canadian rights and interests have been fully protected in accordance with the provisions of the Boundary Waters Treaty." CEQ, after reviewing the draft environmental impact statement on the project, had also recommended that construction be suspended until all environmental impacts were identified and the problems resolved.

After extensive interagency consultations, the United States informed Canada by diplomatic note on February 5, 1974, that: "In any development of features of the Garrison Diversion Unit that will affect Canada, specifically the Red River Basin and the Souris Loop, the United States will comply with its obligation to Canada not to pollute water crossing the boundary 'to the injury of health or property' within Canada. No construction potentially affecting waters flowing into Canada will be undertaken unless it is clear that this obligation will be met." Under this commitment, the Interior Department intends not to proceed beyond completion of construction of the McClusky Canal and Lonetree Reservoir until issues with Canada have been suitably resolved.

USSR

Following the signature of the Agreement on Cooperation in the Field of Environmental Protection by President Nixon and Soviet Chairman Podgorny in May 1972, the US–USSR Joint Committee met for the first time the following September. The first year of cooperation was characterized by exchanges of information, data, and experiences as each side became familiar with the programs of the other. On the basis of these exchanges project plans were made, and the second year was characterized by the implementation of joint working plans and exchanges of personnel for short periods. This will lead to long-term exchanges and integrated joint projects. Participation of the private sector and the academic community has been stressed as a vital part of the program, and nongovernment representatives are members of most of the joint working groups.[60]

Soviet scientists exchanging views with their American counterparts at the Woods Hole Oceanographic Institute at a meeting held under thc auspices of the US–USSR Agreement on Cooperation in the Field of Environmental Protection.

Spain

Under Chapter IV of the Agreement for Friendship and Cooperation, environmental projects of mutual benefit to the United States and Spain are under way. One involves assessing the environmental effects of the oldest continually worked mercury mines in the world, at Almadén, Spain. Other projects are concerned with air monitoring, training of public health officials, and solid waste disposal.[61]

Japan

Environmental cooperation between the United States and Japan has continued on a modest level since U.S.-Japanese ministerial level conferences on environmental policy were held in 1970 and 1971. The first U.S.-Japanese conference on solid waste management took place in Tokyo in January 1973, and a meeting on photochemical smog was held, again in Tokyo, in June 1973. Exchanges of information have followed these and earlier conferences of experts. Work in marine resources, forestry, and national parks has continued under a joint cooperative program with Japan in natural resources.

CEQ Chairman Russell W. Peterson was in Tokyo May 20–24, 1974, for the Third Ministerial Level Conference on Environmental Policy. At the meeting both sides agreed that the consumption of energy is one of the major causes of environmental pollution. They underlined the need for energy conservation and development of clean energy sources. Five new cooperative projects were established: environmental impact assessment; management of bottom sediments containing toxic pollutants; air pollution-related meteorology; health effects of pollutants; and identification and control of toxic substances.[62]

Japan's actions to cope with environmental problems, paralleling and sometimes exceeding those of the United States, are worth close attention. In particular, Japan in 1973 adopted a chemical substances control act, while the United States has yet to enact similar legislation.[63] In 1975 automobile emission standards similar to U.S. standards will be in force in Japan.[64]

Federal Republic of Germany

The Federal Republic of Germany and the United States have a relatively long history of cooperation on mutual pollution problems. Much of this work took place under the Cooperative Program on Natural Resources. Since this created some organizational difficulties on the German side, the German Government suggested that environmental protection be the subject of a separate agreement. The agreement, signed in Bonn on May 9, 1974, goes into effect following ratification by the German states. It provides a formal framework for existing and future cooperative projects in the environmental field. Programs in mining, magnetohydrodynamics, and coal research continue under the Cooperative Program on Natural Resources.[65]

Special Foreign Currency Programs

Using excess foreign currency obtained through past sales of agricultural commodities, EPA has been able to develop environmental study programs in Poland, India, Pakistan, Yugoslavia, Tunisia, and Egypt. The most significant in scope is that with Poland. Studies of water pollution problems were agreed upon in 1973, and new studies of energy related activities in Upper Silesia, a heavily industrialized region, have been negotiated. The agreement with Egypt includes an interdisciplinary study of ecological transformations in Lake Nasser, which is forming behind the Aswan High Dam.[66]

European Communities

The European Communities (EC), comprising the countries of the European Common Market, has shown increased interest in environmental matters and cooperation. A meeting of the EC Council of Environmental Ministers in July 1973 approved an ambitious program that included cooperation with nonmember countries and with other international organizations. At Department of State initiative, a meeting of US and EC environmental officials was held in Brussels, seat of the EC, in November 1973, to discuss possible US–EC environmental cooperation. Both sides agreed to informal

contacts before multilateral environmental meetings, endorsed the importance of the OECD study on pollution costs, and agreed on another meeting in Washington to exchange views on six specific pollutants as well as other matters.

At this meeting, held in February 1974, arrangements were made to continue the series of meetings in September 1974, in Italy, with the following items included in the agenda: pesticides, water pollutants, sulfur dioxide, carbon dioxide, lead measurement techniques and criteria, noise, and carcinogenicity, especially of asbestos. An exchange of letters between the United States and the EC Commission has set forth the parameters of their environmental cooperation.[67]

Multilateral Cooperation

Economic Commission for Europe

The Economic Commission for Europe (ECE) is a unique body in that it crosses the divide between Eastern and Western Europe. The United States has been a member of the ECE from its inception because of the important U.S. economic role in Europe, particularly after World War II. ECE interest in the environment began to crystallize in 1971, when it sponsored a major meeting that led to the formation of the ECE Senior Advisors on the Environment. This group met for the second time in Geneva in February 1974.

ECE environmental activities were briefly described in the last Annual Report.[68] During 1974, the first year of a formally organized environmental program, the ECE sponsored a seminar on environmental statistics and held preparatory meetings for seminars on solid waste and ecological considerations in economic development.

The second session of the ECE Senior Advisors on the Environment reviewed the work of these meetings as well as the wide-ranging studies on the work program. Energy was, naturally, a major focus. A review of the report of the working program on air pollution brought general agreement to emphasize fuel desulfurization. Noise pollution was separated from air pollution and made a new item on the work program. The UNEP Executive Director appeared before the group to describe UNEP activities and UNEP-ECE cooperation, already off to a good start.[69]

Four ECE members—Sweden, Norway, Denmark, and Finland—signed a precedent-setting convention in 1974. Under it a citizen of one country who may be affected by environmentally harmful activity in another country has the right to take legal action in that country to stop or modify that activity and collect damages. This is the first time such a principle has been established in international law.[70]

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Organization for Economic Cooperation and Development

The Environment Committee of the Organization for Economic Cooperation and Development has served as the principal framework within which the more industrialized countries outside of Eastern Europe have been able to concert their efforts in the environmental area, strive to move toward the development of common policies, and seek to assure that disparate environmental policies do not introduce non-tariff trade barriers or distortions in trade. Activities of the Committee should loom even more important as further evaluations are made of key pollution problems, and as efforts are made to standardize measurements and to harmonize environmental and energy policies. Membership consists of Australia, New Zealand, Japan, almost all the countries of Western Europe, Canada, and the United States.

Many industries and many governments have been understandably concerned over possible trade disturbances due to different environmental policies, such as those noted under "Trade" above. The Committee has developed an "early warning system" to signal to other members actions taken in the environment that might significantly affect international trade. However, no clear cases of trade distortions attributable to differing environmental constraints or practices have been brought before the Committee. At its March 4, 1974 meeting, the Environment Committee took note of the fact that in two years of operation, no country had asked for consultations under the procedures set up for this purpose. The notification procedures do serve, however, as a useful means of signaling to environmental authorities in member states that a particular environmental problem is of sufficient importance to have caused another government to act on it.

The four sector groups established by the Committee (air, water, chemicals, urban) and the Subcommittee of Economic Experts continued work on various useful projects.

The Air Sector Group has worked on emission instrumentation techniques for particulates from selected sources, oxidants, pollution from the pulp and paper industry, guidelines for actions to control emissions of sulfur dioxide, and the environmental impact of energy generation.

The Water Sector Group has studied eutrophication, pollutant control techniques, biodegradability of non-ionic synthetic detergents, phenols in water, thermal discharges to water, and impacts of energy production and use on water environment.

The OECD Council adopted recommendations proposed by the Chemical Sector Group on "Measures to Reduce All Man-Made Emission of Mercury into the Environment." Basic work on a similar effort for cadmium was completed. Work was started on a means of screening chemicals for environmental effect—a project also of in-

terest to UNEP. Information continued to be exchanged on the implementation of the Council Decision on Polychlorinated Biphenyls.

The Urban Sector Group continued work on the environmental impacts of airport development, on policy instruments for influencing urban growth, and on noise.

The Subcommittee of Economic Experts further developed its economic analyses of transfrontier pollution problems. An ad hoc group on transfrontier pollution was created to carry the work on this subject beyond the economic aspects and to develop appropriate guiding principles in this area.[71]

A ministerial level meeting of the Environment Committee is scheduled for November 1974. At that time it is anticipated that the achievements of the Committee will be subjected to comprehensive review and that, hopefully, agreements will be reached on some broad common objectives for the next decade as well as additional specific joint enterprises.

Committee on the Challenges of Modern Society

The North Atlantic Treaty Organization's Committee on the Challenges of Modern Society (CCMS), established in 1969 at President Nixon's recommendation, has continued to expand on a number of multilateral pilot projects. Three new projects proposed by the United States involve the development of solar and geothermal energy, and energy conservation.

In the field of air quality, the United States, as the lead country, has presented a final report containing 15 action recommendations with respect to air quality assessment, control technology, modeling, and low-pollution power systems development. Assessment studies have been or are being carried out in Ankara, Frankfurt, Oslo, Milan, Turin, St. Louis, Mo., and Rotterdam and Limburg Province, The Netherlands. The low-pollution power systems development work is now being modified to include energy conservation as an additional parameter.

In the field of water quality, a Canadian-led project is concluding with recommendations on effective water quality planning methods, examination of simulation models as decision-making tools, examination of the effectiveness of economic instruments such as subsidies in preventing or minimizing inland water pollution, and analysis of the process whereby water quality standards and criteria are set in an interjurisdictional setting. A British-led project on advanced wastewater treatment has involved construction of demonstration plants using an advanced physical/chemical treatment process in the United Kingdom and a pure oxygen process in Germany.

Foreseeing an increased need to develop new and cleaner sources

of energy as well as reduce energy consumption, the United States proposed initiation of new projects on solar heating and cooling systems for buildings, development of geothermal resources, and energy conservation. The projects on solar and geothermal energy, which will involve a number of non-NATO countries, were approved in October 1973. The Energy Conservation Project, approved in May 1974, is designed to provide information and data from Europe with respect to energy conservation in buildings, industry, and transportation.[72]

Conclusion

International action in the environmental field continues to expand. The past year has seen further development of international institutions that focus on international environmental problems.

This year's report has concentrated on the United Nations Environment Program. The rapid development of this new organization is heartening. Its growth has encouraged nations in all stages of development to understand the need for environmental concern. UNEP is institutionalizing environmental concern on a global scale just as NEPA has done on a national scale in the United States.

This coming year will constitute a major test of whether independent nation-states can cooperate effectively in addressing critical environmental issues that can only be solved collectively. How will the inhabitants of this planet face the problems of rapid population growth? The World Population Conference may help us begin to answer this question. How will the nations of the world provide food for billions? The World Food Conference may guide us. Will we be able to devise new principles of international law to protect the oceans from environmental deterioration? The Law of the Sea Conference will deal with some aspects of this problem.

In summary, momentum generated by the Stockholm Conference is both evident and growing. We are far from resolving our problems, but we have made an auspicious beginning.

The United States has played an important role in furthering environmental protection internationally, not only in encouraging the development of UNEP, but also in other international organizations such as the OECD and NATO. Its bilateral activities add another important dimension.

Time seems to have speeded up in the twentieth century. Exponential growth curves in almost all fields start low and suddenly, towards the beginning of this century, jump to incredible heights. International environmental problems fit into this pattern. Fortunately, the curves charting international environmental concern and action are also rising steeply now, and that can only be encouraging.